DEVELOPING A STATE WATER PLAN

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1983

by

Cynthia L. Appel and others

United States Geological Survey

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CONVERSION FACTORS

Most values are given in this report in inch-pound units followed by metric units in parentheses. The conversion factors used are shown to four significant figures. However, in the text, the metric equivalents are shown only to the number of significant figures consistent with the accuracy of the value in inch-pound units.

Multiply	By	To obtain
Acre-foot (acre-ft)	0.001233	Cubic hectometer (hm^3)
Foot (ft)	0.3048	Meter (m)
Inch (in.)	25.40	Millimeter (mm)
Mile (mi)	1.609	Kilometer (km)

Chemical concentration is given only in metric units—milligrams per liter (mg/L). For concentrations less than 7,000 mg/L, the numerical value is about the same as for concentrations in parts per million.

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INTRODUCTION

This is the twentieth in a series of annual reports that describe ground-water conditions in Utah. Reports in the series, prepared cooperatively by the U.S. Geological Survey and the Utah Division of Water Resources, provide data to enable interested parties to keep abreast of changing ground-water conditions.

This report, like the others in the series, contains information on well construction, ground-water withdrawals, water-level changes, and related changes in precipitation and streamflow. Supplementary data such as graphs showing chemical quality of water and maps showing ground-water level contours are included in reports of this series only for those years or areas for which applicable data are available and are important to a discussion of changing ground-water conditions.

The report includes individual discussions of selected major areas of ground-water development in the State for the calendar year 1982. Water-level fluctuations, however, are described for spring 1982 to spring 1983 and spring 1963 to spring 1983. Much of the data used in the report were collected by the Geological Survey in cooperation with the Division of Water Rights, Utah Department of Natural Resources.

The following reports dealing with ground water in the State were released by the Geological Survey during 1982:

Aquifer systems in the Great Basin Region of Nevada, Utah, and adjacent States—A study plan, by James Harrill and others, U.S. Geological Survey Open File Report 82-445.

Bedrock aquifers in the northern San Rafael Swell area, Utah, with special emphasis on the Navajo Sandstone, by J. W. Hood and D. J. Patterson, U.S. Geological Survey Open-File Report 82-866 (pending publication as Utah Department of Natural Resources Technical Publication 78).

Ground-water conditions in Utah, spring of 1982: Utah Division of Water Resources Cooperative Investigations Report 22, 85 p.

Ground-water reconnaissance of the central Weber River area, Morgan and Summit Counties, Utah, by J. S. Gates, Judy I. Steiger, and Ronald T. Green, U.S. Geological Survey Open-File Report 82-695 (pending publication as Utah Department of Natural Resources Technical Publication 77).

Ground-water resources of the northern Wasatch Front area, by Don Price and Barbara LaPray, Utah Geological and Mineral Survey Wasatch Front Environment and Resource Map 53-D (in press).

Hydrology of the Gunnison-Fairview-Nephi area, central Utah, by J. S. Gates, *in* Overthrust Belt of Utah, 1982 Symposium and Field Conference: Utah Geological Association Publication 10, p. 151-162.

Hydrology of the southern Wasatch Plateau coal-resource area, central Utah, by T. W. Danielson and D. A. Sylla, U.S. Geological Survey Water-Resources Investigations Report 82-4009.

Regional hydrology of the Green River—Moab area, northwestern Paradox Basin, Utah, by F. E. Rush, M. S. Whitfield, and I. M. Hart, U.S. Geological Survey Open-File Report 82-107.

Results of an aquifer test near Lynndyl, Utah, by W. F. Holmes and D. E. Wilberg, U.S. Geological Survey Open-File Report 82-514.

Results of hydraulic tests in U.S. Department of Energy's wells DOE-4, 5, 6, 7, 8, and 9, Salt Valley, Grand County, Utah, by Leonard E. Wollitz, William Thordason, Merrick S. Whitfield, Jr., and James E. Weir, U.S. Geological Survey Open-File Report 82-346.

Selected ground-water data, Sevier Desert, Utah, 1935-82, by Michael Enright and W. F. Holmes, U.S. Geological Survey Open-File Report 82-910 (also duplicated as Utah Hydrologic-Data Report 37).

Selected hydrologic data for northern Utah Valley, Utah, 1935-82, Cynthia L. Appel, David W. Clark, and Paul E. Fairbanks, U.S. Geological Survey Open-File Report 82-1023 (also duplicated as Utah Hydrologic-Data Report 39).

Selected hydrologic data, Price River basin, Utah, water years 1979 and 1980, by K. M. Waddell, J. E. Dodge, D. W. Darby, and S. M. Theobald, U.S. Geological Survey Open-File Report 82-916 (also duplicated as Utah Hydrologic-Data Report 38).

UTAH'S GROUND-WATER RESERVOIRS

Small quantities of ground water can be obtained from wells throughout much of Utah, but large supplies that are of suitable chemical quality for irrigation, public supply, or industrial use generally can be obtained only in specific areas. The major areas of ground-water development discussed in this report are shown in figure 1 and named in table 1. Relatively few wells outside of these areas yield large supplies of water of good chemical quality for the uses listed above, although some of the basins in western Utah and many areas in eastern Utah have not been explored sufficiently to determine their potential for ground-water development.

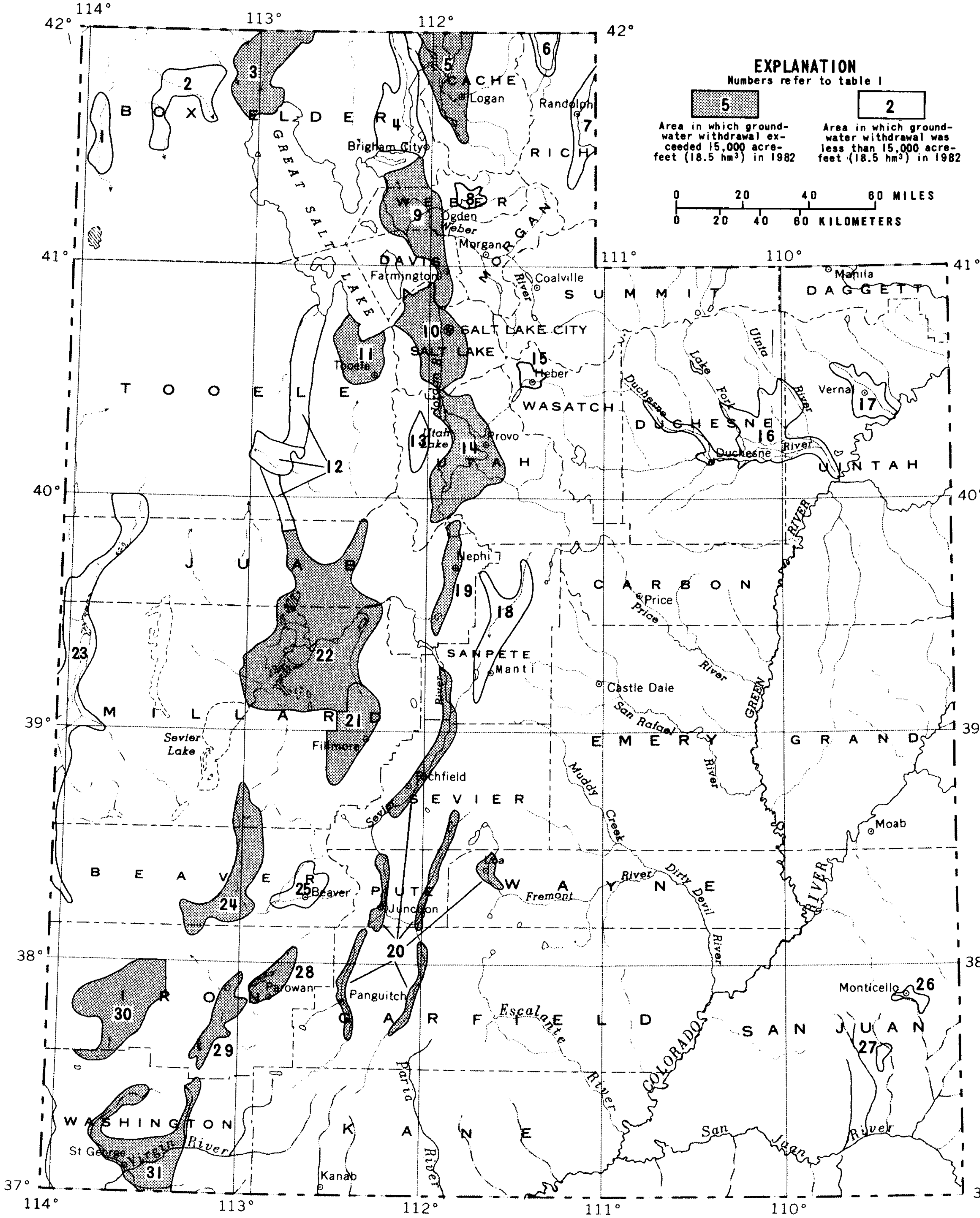


Figure 1.—Areas of ground-water development specifically referred to in this report.

Table 1.—Areas of ground-water development in Utah specifically referred to in this report

Number in figure 1	Area	Principal type of water-bearing rocks
1	Grouse Creek valley	Unconsolidated
2	Park Valley	Do.
3	Curlew Valley	Unconsolidated and consolidated
4	Malad-lower Bear River valley	Unconsolidated
5	Cache Valley	Do.
6	Bear Lake valley	Do.
7	Upper Bear River valley	Do.
8	Ogden Valley	Do.
9	East Shore area	Do.
10	Salt Lake (Jordan) Valley	Do.
11	Tooele Valley	Do.
12	Dugway area	Do.
	Skull Valley	Do.
	Old River Bed	Do.
13	Cedar Valley	Do.
14	Utah and Goshen Valleys	Do.
15	Heber Valley	Do.
16	Duchesne River area	Unconsolidated and consolidated
17	Vernal area	Do.
18	Sanpete Valley	Unconsolidated
19	Juab Valley	Do.
20	Central Sevier Valley	Do.
	Upper Sevier Valleys	Do.
	Upper Fremont River valley	Unconsolidated and consolidated
21	Pavant Valley	Do.
22	Sevier Desert	Unconsolidated
23	Snake Valley	Do.
24	Milford area	Do.
25	Beaver Valley	Do.
26	Monticello area	Do.
27	Blanding area	Do.
28	Parowan Valley	Unconsolidated and consolidated
29	Cedar City Valley	Unconsolidated
30	Beryl-Enterprise area	Do.
31	Central Virgin River area	Unconsolidated and consolidated

About 2 percent of the wells in Utah obtain water from consolidated rocks. The consolidated rocks that yield the most water are lava flows, such as basalt, which contain interconnected vesicular openings or fractures; limestone, which contains fractures or other openings enlarged by solution; and sandstone, which contains open fractures. Most of the wells that tap consolidated rocks are in the eastern and southern parts of the State in areas where water supplies cannot be obtained readily from unconsolidated rocks.

About 98 percent of the wells in Utah draw water from unconsolidated rocks. These rocks may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these materials. Wells obtain the largest yields from the coarser materials that are sorted into deposits of uniform grain size. Most wells that tap unconsolidated rocks are in large intermountain basins, which have been partly filled with rock material eroded from the adjacent mountains.

SUMMARY OF CONDITIONS

The estimated total withdrawal of water from wells in Utah in 1982 was about 794,000 acre-feet (979 hm^3), which is about 49,000 acre-feet (60 hm^3) less than in 1981, and 32,000 acre-feet (39 hm^3) less than the 1972-81 average annual withdrawal (table 2). The decrease in withdrawal primarily was due to a decrease in withdrawal for irrigation. Total withdrawal for irrigation in 1982 was about 504,000 acre-feet (621 hm^3) (table 2), which is 44,000 acre-feet (54 hm^3) less than reported for 1981. Withdrawal for public supply was 146,000 acre-feet (180 hm^3) in 1982 which was 5,000 acre-feet (6.2 hm^3) less than in 1981. Withdrawals for industry and domestic and stock in 1982 were 82,000 and 60,000 acre-feet (101 and 74 hm^3), respectively, which were about the same as in 1981.

The quantity of water withdrawn from wells is related to local climatic conditions. Precipitation in 1982 was above average in almost all of Utah (National Oceanic and Atmospheric Administration, 1983). Of the 33 stations for which graphs of cumulative departure from average annual precipitation are included in this report, only 2 had below average precipitation in 1982. A result of the above average precipitation was above average surface-water supplies and therefore less water was withdrawn for irrigation.

The above average precipitation in most of the State in 1982 resulted in increased recharge to the ground-water reservoirs. This, coupled with decreased withdrawals, resulted in rises in ground-water levels in most of the State from spring of 1982 to spring of 1983. Continued large withdrawal for irrigation, however, resulted in general declines of ground-water levels in the Milford and Beryl-Enterprise areas of Escalante Valley.

In the northern part of the State, ground-water levels generally were higher in the spring of 1983 than in the spring of 1963. The higher levels probably were because precipitation and therefore recharge generally was above normal in 1983 and below normal in 1963. Water levels generally were low in 1963. In the southern part of the State, ground-water levels generally were lower in 1983 than in 1963, probably because of continued large withdrawals for irrigation.

Table 2.—Well construction and withdrawal of water from wells in Utah

Number of wells constructed in 1982.--Data provided by Utah Department of Natural Resources, Division of Water Rights. Includes deepened and replacement wells.

Diameter of 6 inches or more.--Constructed for irrigation, industry, or public supply.

Estimated withdrawals from wells.--

1981 total: From Holmes and others (1982, table 2).

1972-81 average annual: Calculated from previous reports of this series and also includes some previously unpublished revisions.

Area	Number in figure 1	Number of wells completed in 1982: Total	Number of wells completed in 1982: Diameter of 6 inches or more	Estimated withdrawal from wells (acre-feet), 1982: Irrigation	1982: Industry	1982: Public supply	1982: Domestic and stock	1982: Total (rounded)	1981 total	1972-81 average annual
Curlew Valley	3	0	0	25,600	0	50	50	26,000	40,000	27,000
Cache Valley	5	21	0	11,900	9,100	3,600	1,800	26,000	33,000	27,000
East Shore area	9	18	4	[1] 9,000	7,300	25,500	–	42,000	36,000	41,000
Salt Lake (Jordan) Valley	10	41	8	1,900	30,100	58,600	30,000	121,000	136,000	128,000
Tooele Valley	11	17	4	[1] 19,800	500	5,100	150	26,000	30,000	30,000
Utah and Goshen Valleys	14	47	1	47,700	10,200	15,600	12,800	86,000	101,000	102,000
Juab Valley	19	3	1	15,000	50	750	200	16,000	21,000	24,000
Sevier Desert	22	37	9	13,200	1,500	860	270	16,000	18,000	31,000
Upper and central Sevier Valleys and upper Fremont River valley	20	34	3	16,000	200	5,000	6,300	28,000	25,000	23,000
Pavant Valley	21	9	3	68,600	100	100	300	69,000	80,000	91,000
Cedar City Valley	29	8	1	[2] 23,700	900	4,500	3,200	32,000	29,000	33,000
Parowan Valley	28	2	0	[2,3] 24,100	300	200	200	25,000	27,000	29,000
Escalante Valley										
Milford area	24	5	1	53,700	0	1,000	300	55,000	69,000	61,000
Beryl-Enterprise area	30	5	4	[2] 79,600	18,200	320	750	99,000	93,000	80,000
Other areas[4]		339	41	93,800	3,700	25,200	4,000	127,000	105,000	99,000
Totals (rounded)		586	80	504,000	82,000	146,000	60,000	794,000	843,000	826,000

[1] Includes some domestic and stock use.

[2] Data from reports of local water commissioners to the Utah Department of Natural Resources, Division of Water Rights.

[3] Includes some use for stock.

[4] Withdrawals are estimated minimum amounts.

The total number of wells drilled during 1982 (table 2), as indicated by well-drillers' reports filed with the Utah Division of Water Rights, was about the same as reported for 1981. The number of those wells constructed for public supply, irrigation, and industrial use was also about the same as reported for 1981.

The larger ground-water basins and those containing most of the ground-water development in Utah are shown in figure 1. Table 2 gives information about the number of wells constructed, withdrawals of water from wells for principal uses, and total withdrawals in 1982 for selected major ground-water basins. For comparison, total withdrawals in 1981 and average annual withdrawals during the 10-year period 1972-81 also are shown in table 2. Table 3 shows the annual withdrawals from the major basins for 1972-81.

Table 3.—Total annual withdrawal of water from wells in major areas of ground-water development in Utah, 1972-81

[From previous reports in this series.]

Area	Number in figure 1	Thousands of acre-feet									
		1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Curlew Valley	3	20	19	22	21	27	31	27	29	30	40
Cache Valley	5	23	24	24	25	27	32	26	28	25	33
East Shore area	9	40	41	47	38	37	48	36	46	45	36
Salt Lake (Jordan) Valley	10	124	129	130	122	124	119	127	136	128	[1] 136
Tooele Valley	11	29	29	33	29	30	28	30	30	27	30
Utah and Goshen Valleys	14	91	89	106	98	107	118	104	107	94	101
Juab Valley	19	30	17	31	25	29	29	19	21	15	21
Sevier Desert	22	38	20	26	26	34	50	40	45	13	18
Upper and central Sevier Valleys and upper Fremont River valley	20	19	19	20	24	25	26	26	24	24	25
Pavant Valley	21	99	69	101	98	95	117	88	86	75	80
Cedar City Valley	29	35	27	42	28	37	40	31	32	28	29
Parowan Valley	28	28	26	31	28	34	33	29	30	28	27
Escalante Valley											
Milford area	24	59	52	70	60	65	65	58	49	61	69
Beryl-Enterprise area	30	77	74	93	85	79	81	71	79	71	93
Other areas		80	76	101	79	106	126	112	112	90	105
Totals		792	711	877	786	856	943	824	854	754	[1] 843

[1] Previously unpublished revision.

MAJOR AREAS OF GROUND-WATER DEVELOPMENT

CURLEW VALLEY

by L. R. Herbert

Withdrawal of water from wells in Curlew Valley in 1982 was about 26,000 acre-feet (32 hm^3), a decrease of 14,000 acre-feet (17 hm^3) from the amount reported in 1981, and 1,000 acre-feet (1.2 hm^3) less than the 1972-81 average annual withdrawal (table 2). The decrease was due to decreased withdrawal for irrigation.

Water levels in Curlew Valley generally rose from March 1982 to March 1983 (fig. 2) due to decreased withdrawal for irrigation and increased recharge from precipitation. The small area of decline west of Snowville was due to continual local withdrawals for irrigation.

The relation of water levels in two selected observation wells to cumulative departure from average annual precipitation at Snowville and annual withdrawals from wells is shown in figure 3. Although water levels rose from 1982 to 1983, water levels in wells (B-12-11)16cdc-1 and (B-14-9)7bbb-1 generally have declined since at least 1965 due to increased withdrawals from wells. Precipitation at Snowville in 1982 was 21.98 inches (558 mm), 9.64 inches (245 mm) above the 1941-82 average annual precipitation.

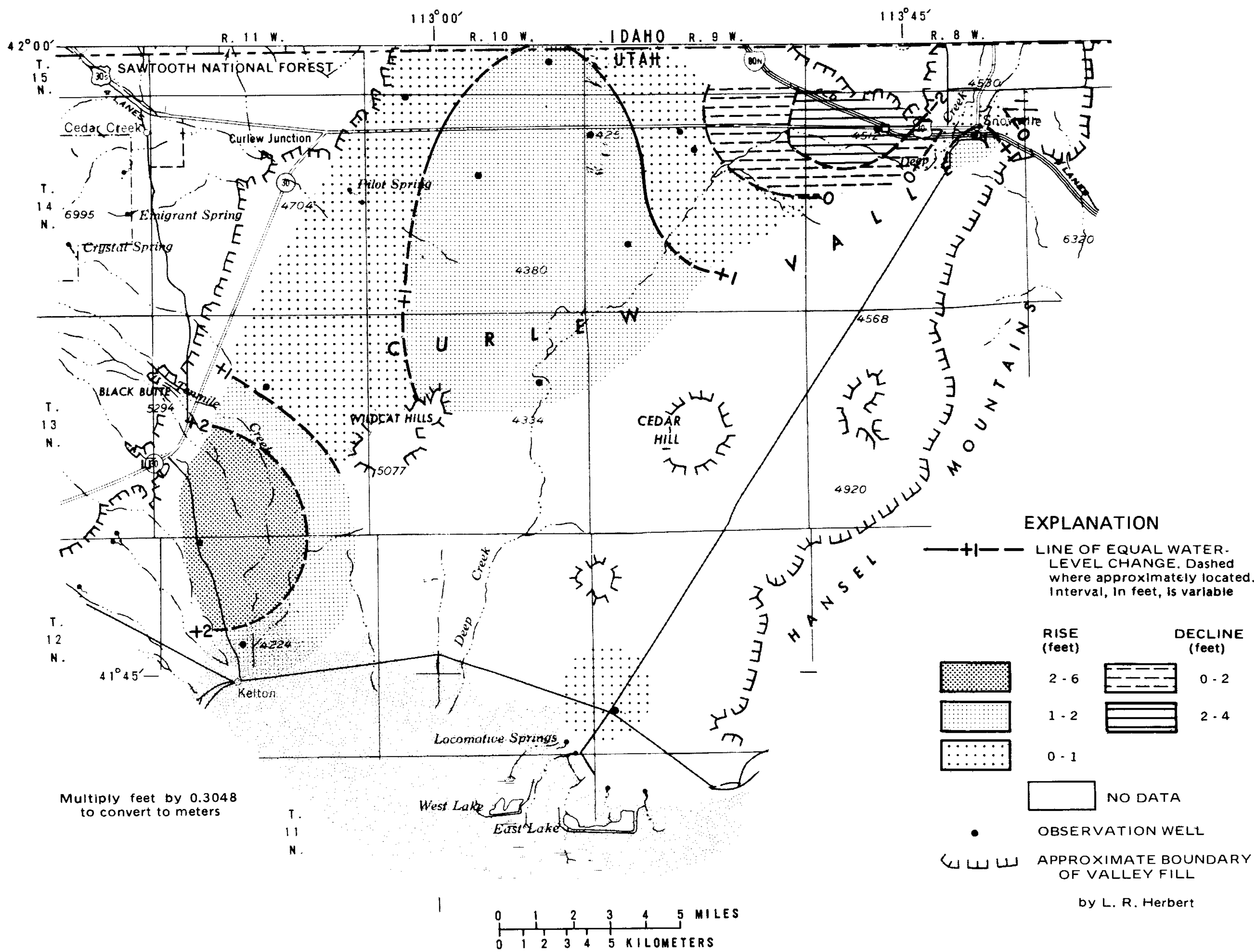


Figure 2.—Map of Curlew Valley showing change of water levels from March 1982 to March 1983.

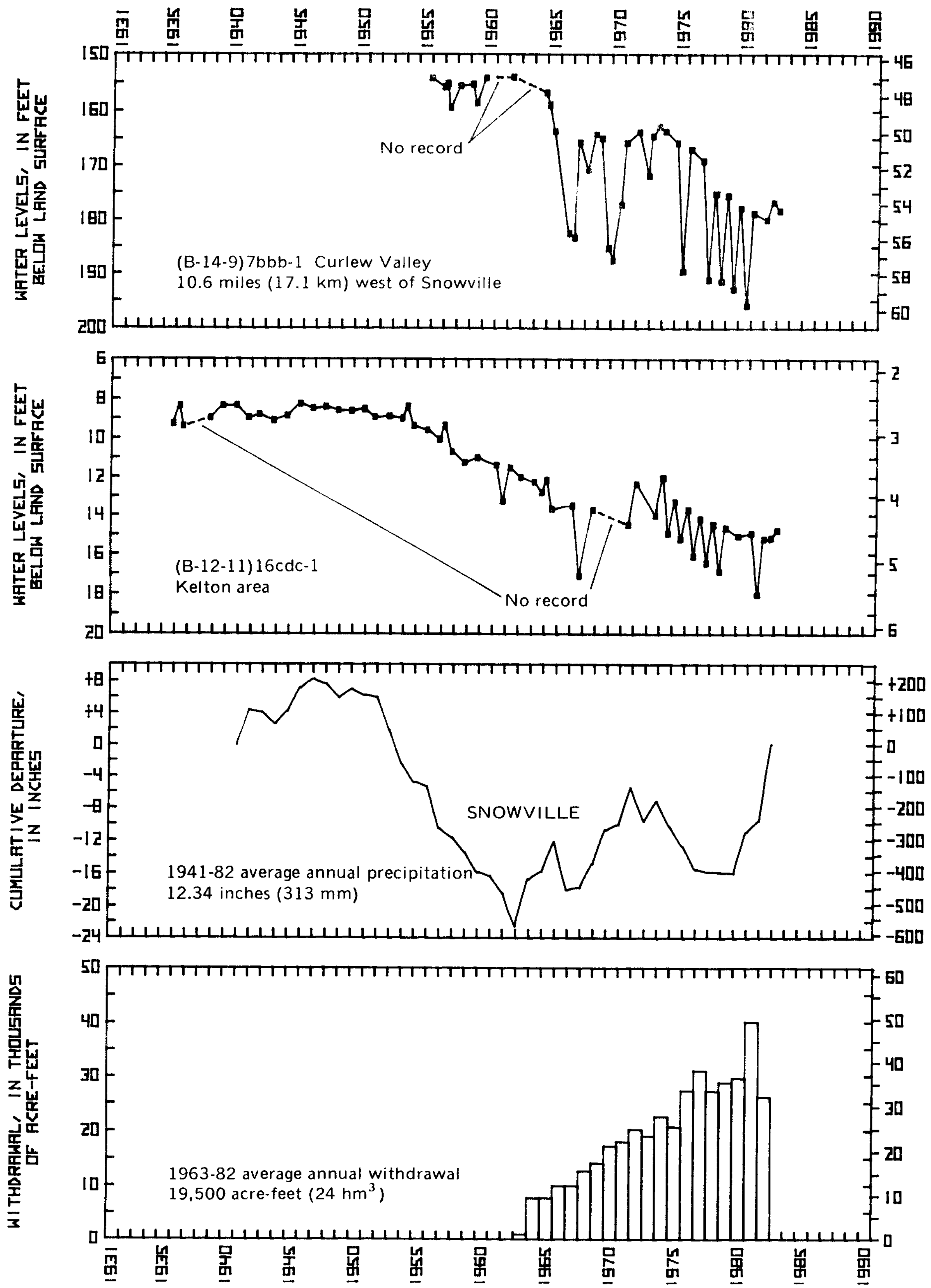


Figure 3.—Relation of water levels in selected wells in Curlew Valley to cumulative departure from the average annual precipitation at Snowville and to annual withdrawals from wells.

CACHE VALLEY

by Don A. Bischoff

Approximately 26,000 acre-feet (32 hm^3) of water was withdrawn from wells in Cache Valley in 1982. This was 7,000 acre-feet (8.6 hm^3) less than the amount withdrawn in 1981 and 1,000 acre-feet (1.2 hm^3) less than the 1972-81 average annual withdrawal (table 2). This decrease was due mainly to less withdrawals for irrigation and public supply.

Water levels in most of Cache Valley rose from March 1982 to March 1983 due to above average precipitation and the decreased withdrawal (fig. 4). Rises of nearly 9 feet (2.7 m) occurred in the Providence-Hyrum area. Declines of less than 1 foot (0.3 m) were measured northwest of Newton, north of Paradise, and northwest of Richmond.

Water levels from March 1963 to March 1983 rose in most of Cache Valley (fig. 5). The largest rise of nearly 8 feet (2.4 m) occurred north of Newton. The only decline, less than 1 foot (0.3 m), occurred in the southern part of the area near Paradise.

The long-term trend of water levels in well (A-12-1)29cab-1, annual discharge of the Logan River near Logan, cumulative departure from average annual precipitation at Logan Utah State University, and annual withdrawals from wells are shown for comparison in figure 6. Discharge of the Logan River during 1982 was 246,600 acre-feet (304 hm^3), which is 126,900 acre-feet (156 hm^3) more than reported in 1981, and 66,600 acre-feet (82.1 hm^3) more than the 1941-82 average annual discharge. Precipitation in 1982 was 28.42 inches (722 mm), 10.17 inches (258 mm) above the 1941-82 average annual precipitation. The above average precipitation resulted in above average streamflow and decreased ground-water withdrawal in most of the valley.

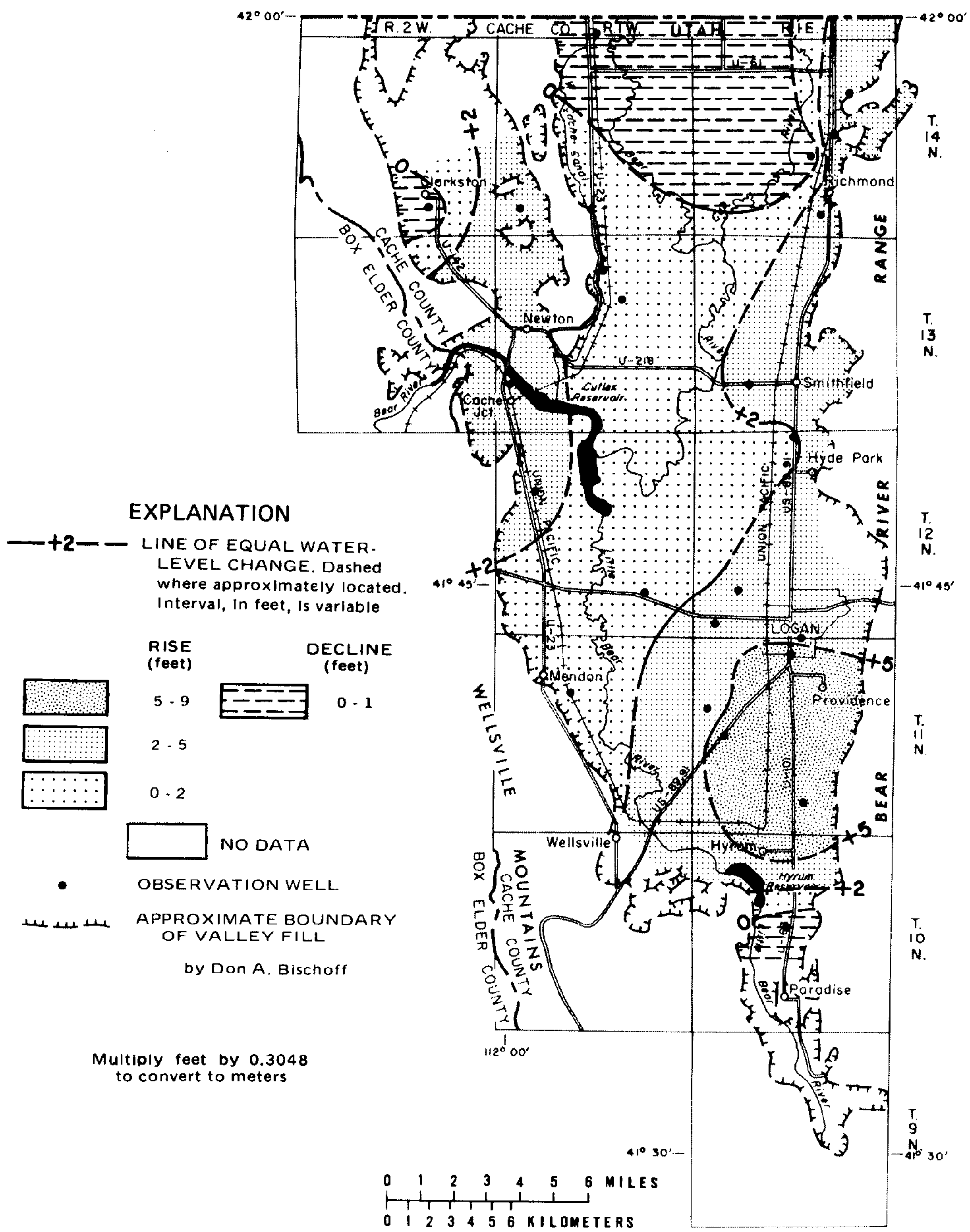


Figure 4.—Map of Cache Valley showing change of water levels from March 1982 to March 1983.

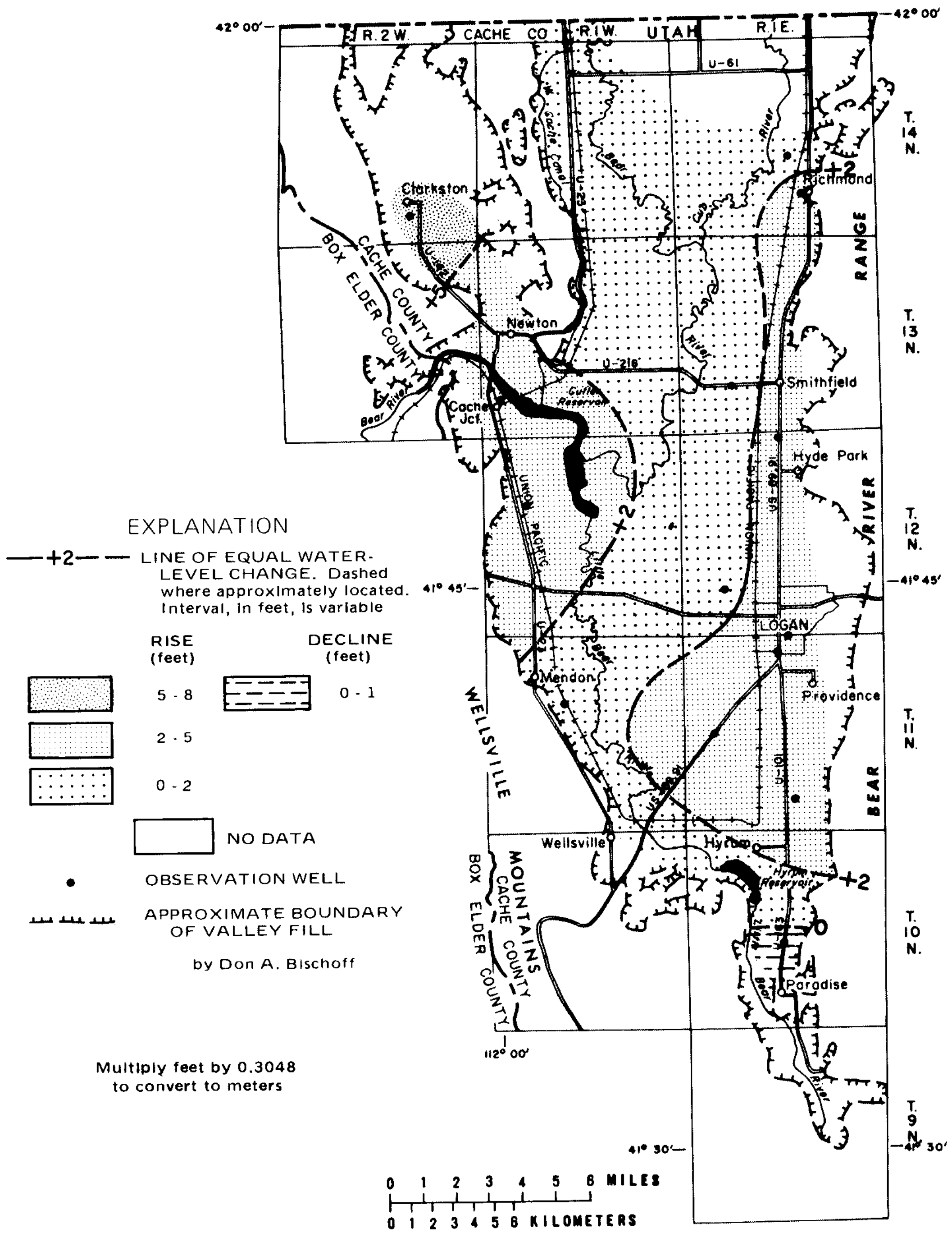


Figure 5.—Map of Cache Valley showing change of water levels from March 1963 to March 1983.

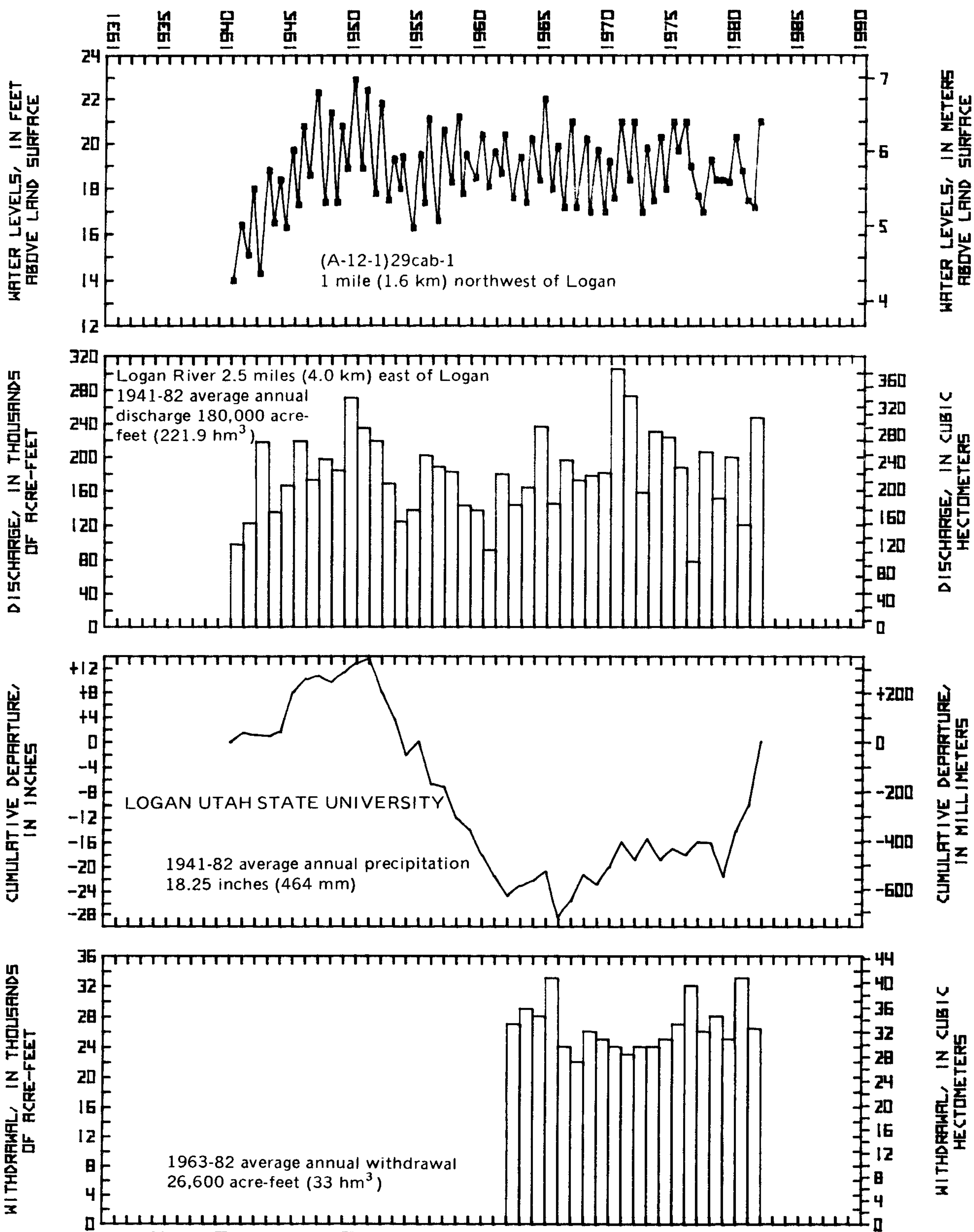


Figure 6.—Relation of water levels in well (A-12-1)29cab-1 in Cache Valley to discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at Logan Utah State University, and to annual withdrawals from wells.

EAST SHORE AREA

by Melanie E. Smith

Withdrawal of water from wells in the East Shore area in 1982 was about 42,000 acre-feet (52 hm^3), 6,000 acre-feet (7.4 hm^3) more than the withdrawal in 1981, and 1,000 acre-feet (1.2 hm^3) more than the 1972-81 average annual withdrawal (table 2). The increased withdrawal was due to increased public supply and industrial use.

Water levels from March 1982 to March 1983 rose in most of the East Shore area (fig. 7) due to above average precipitation. Declines of up to about 4 feet (1.2 m) occurred in the Clearfield-West Point area possibly due to continual withdrawals for public supply.

Water levels from February-March 1963 to March 1983 declined in most of the East Shore area (fig. 8). Declines of up to 29 feet (8.8 m) occurred in the Clearfield-West Point area, probably due to increased withdrawals for public supply. Rises of up to 16 feet (4.9 m) occurred in the Bountiful area.

The long-term relation of water levels in selected observation wells to precipitation at the Ogden Pioneer Powerhouse and withdrawal from wells is shown in figure 9. The 1982 precipitation of 31.38 inches (797 mm) at the Ogden Pioneer Powerhouse was 10.11 inches (257 mm) above the 1937-82 average annual precipitation at that site. The rise in water levels as shown in three of the four observation wells reflects the effect of this above average precipitation.

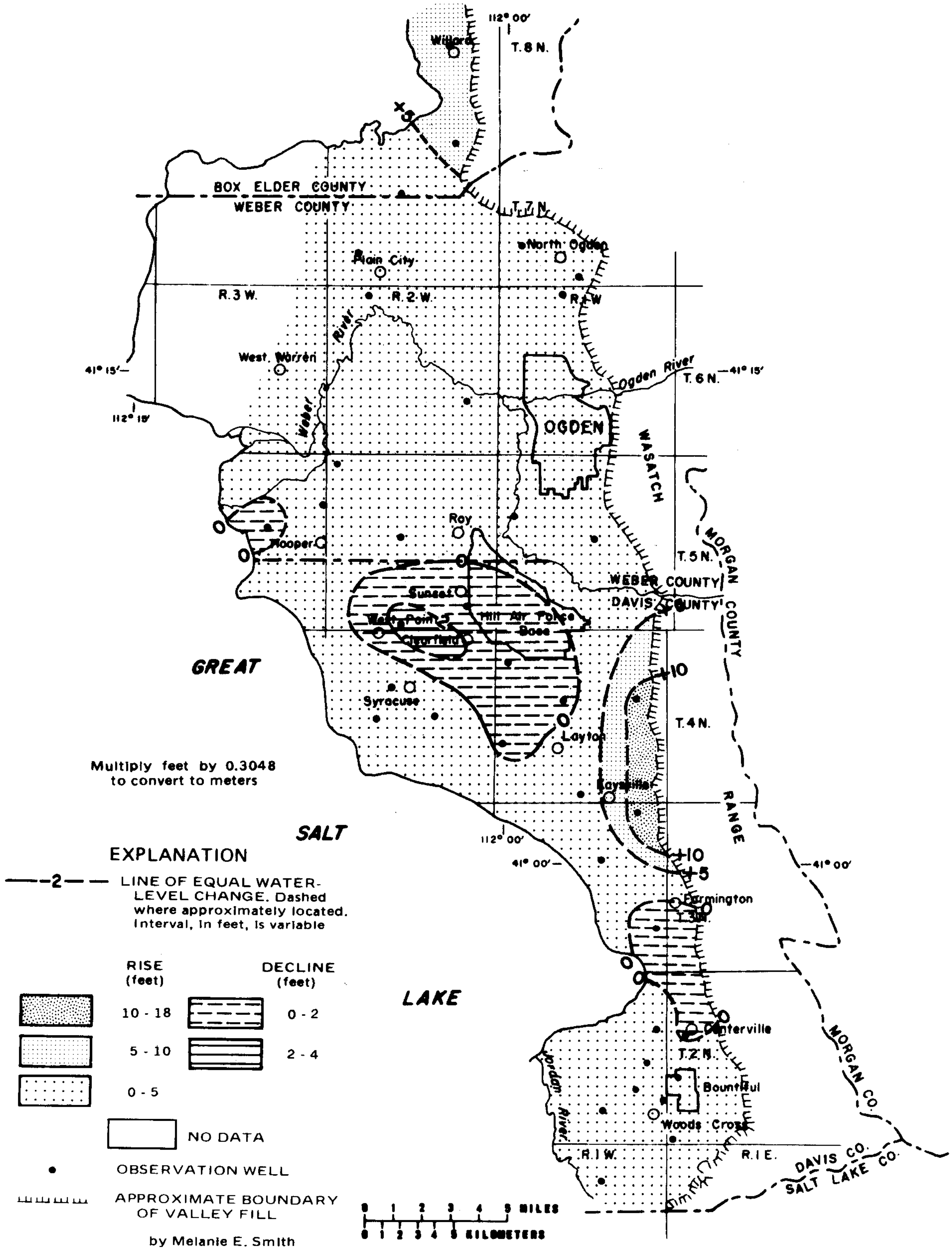


Figure 7.—Map of East Shore area showing change of water levels from March 1982 to March 1983.

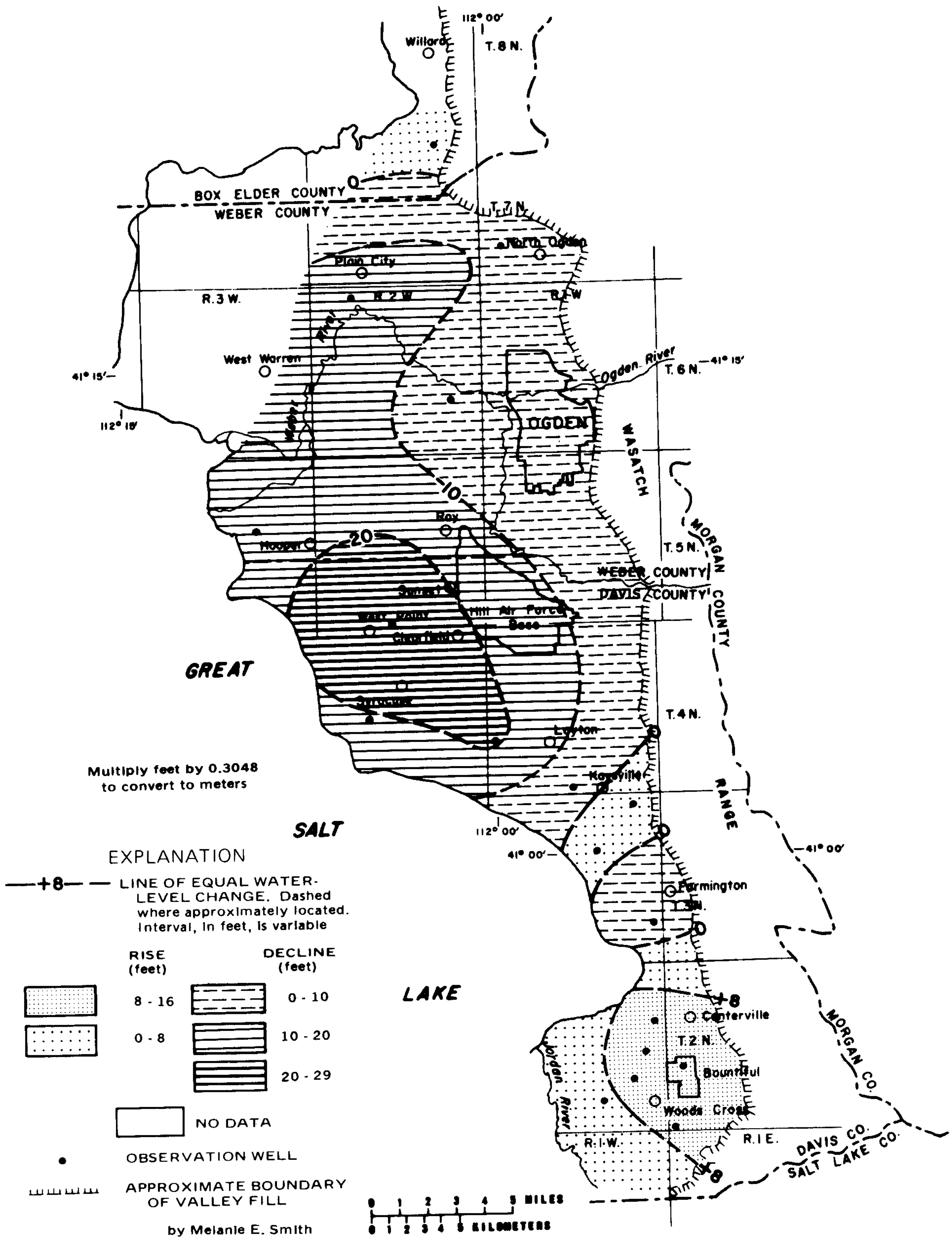


Figure 8.—Map of East Shore area showing change of water levels from February-March 1963 to March 1983.

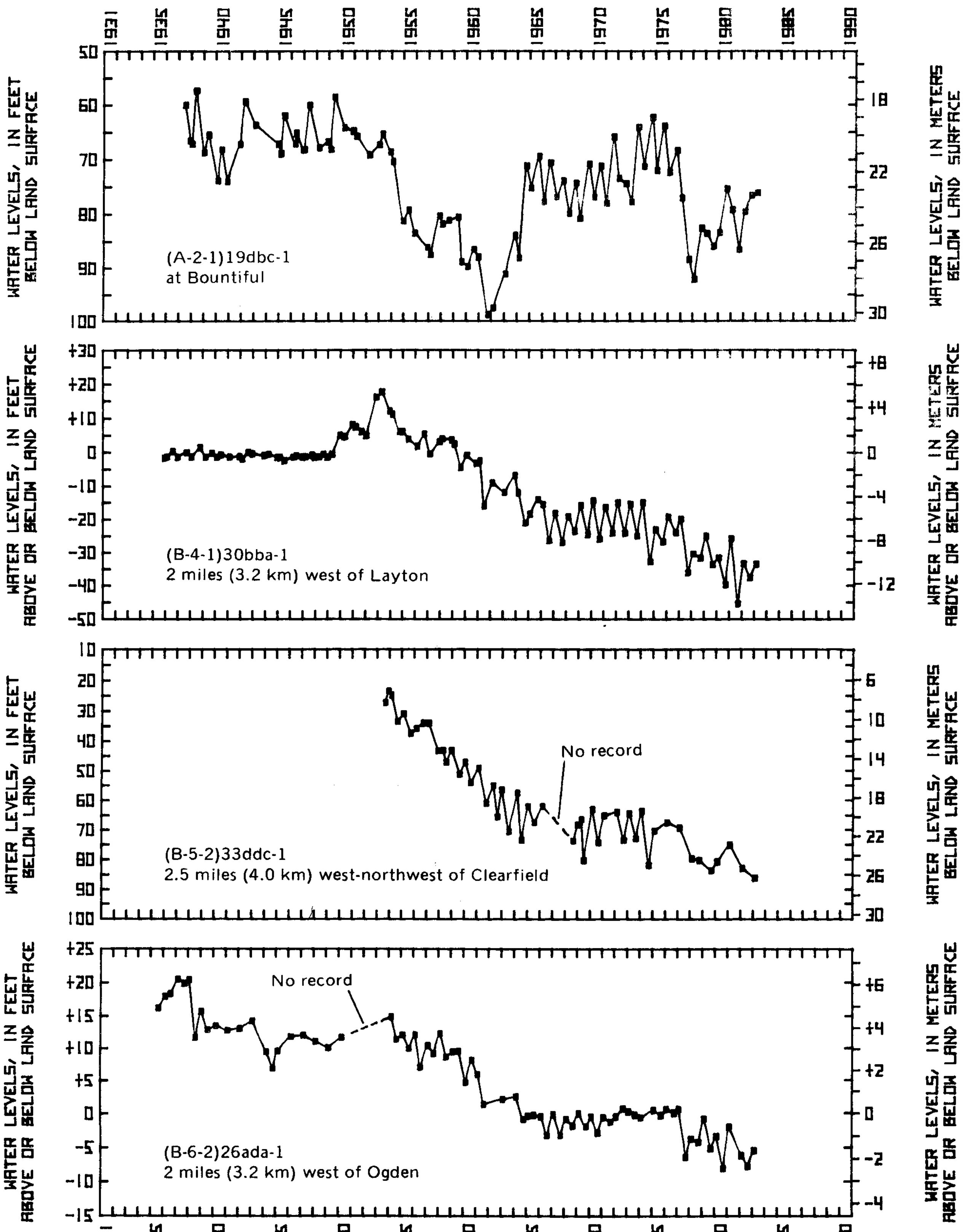


Figure 9.—Relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer Powerhouse and to annual withdrawals from wells.

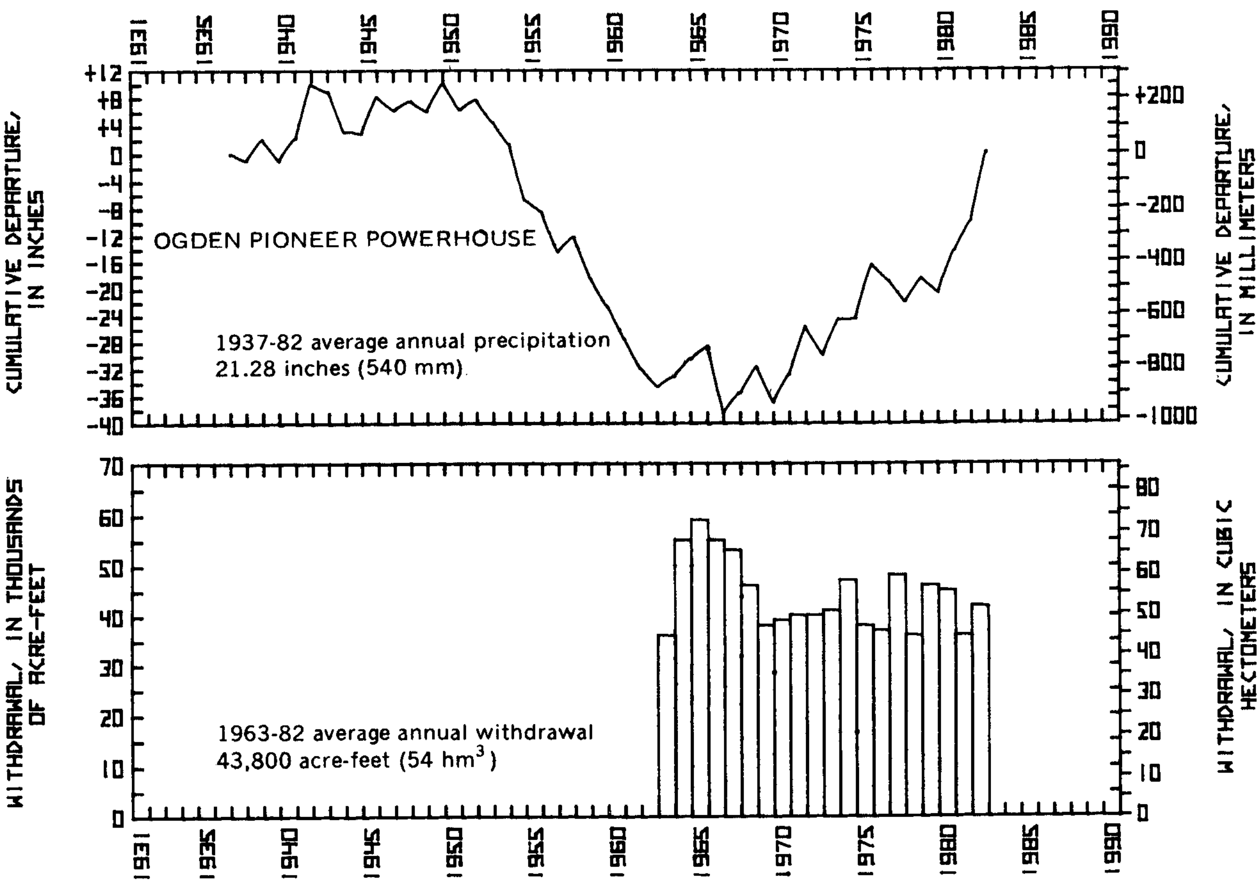


Figure 9.—Continued

SALT LAKE (JORDAN) VALLEY

by Ralph L. Seiler

Withdrawal of water from wells in Salt Lake Valley in 1982 was about 121,000 acre-feet (149 hm^3), about 15,000 acre-feet (18 hm^3) less than in 1981, and 7,000 acre-feet (9 hm^3) less than the 1972-81 average annual withdrawal (table 2). The estimate for 1981 (Holmes and others, 1982, table 2) was revised based on additional data. Withdrawals in 1982 for irrigation, industry, and domestic and stock decreased slightly. Withdrawal for public supply was about 11,000 acre-feet (14 hm^3) less than the 69,700 acre-feet (86 hm^3) withdrawn in 1981. Decreased withdrawals for irrigation and domestic and stock use probably were due to above average precipitation, whereas decreased withdrawal for public supply probably was due to above average availability of surface-water supplies from reservoirs.

Water levels generally rose from February 1982 to February 1983 in Salt Lake Valley (fig. 10). The average net rise was about 2.0 feet (0.61 m). Rises were less than 2 feet (0.6 m) in 55 percent, from 2 to 5 feet (0.6 to 1.5 m) in about 30 percent, from 5 to 10 feet (1.5 to 3.0 m) in about 8 percent, and greater than 10 feet (3.0 m) in less than 0.5 percent of the valley. The largest rises were along the east bench, indicating increase in recharge to the ground-water system as a result of the above average precipitation. Water levels declined less than 1 foot (0.3 m) in about 7 percent of the valley.

Water levels rose in about 78 percent of the valley from January-March 1963 to February 1983 (fig. 11). The average net rise over the entire valley was about 2.5 feet (0.76 m). The largest rises, more than 20 feet (6.1 m), were in the northeast part of Salt Lake City. The rises probably were due chiefly to a net increase in precipitation and therefore recharge. Declines of more than 10 feet (3.0 m) occurred in about 10 percent of the valley (the area east of Sandy, Midvale, and Murray). These declines probably were caused by increased withdrawals for public supply in this area.

The relation of water levels in selected observation wells to precipitation, total annual and public-supply withdrawals from wells, and population is shown in figures 12 and 13. Water levels rose in all wells for which hydrographs are shown. Precipitation at Silver Lake Brighton was 19.51 inches (496 mm), and that at the Salt Lake City WSO (International Airport), was 7.91 inches (201 mm) above the 1931-82 average annual precipitation.

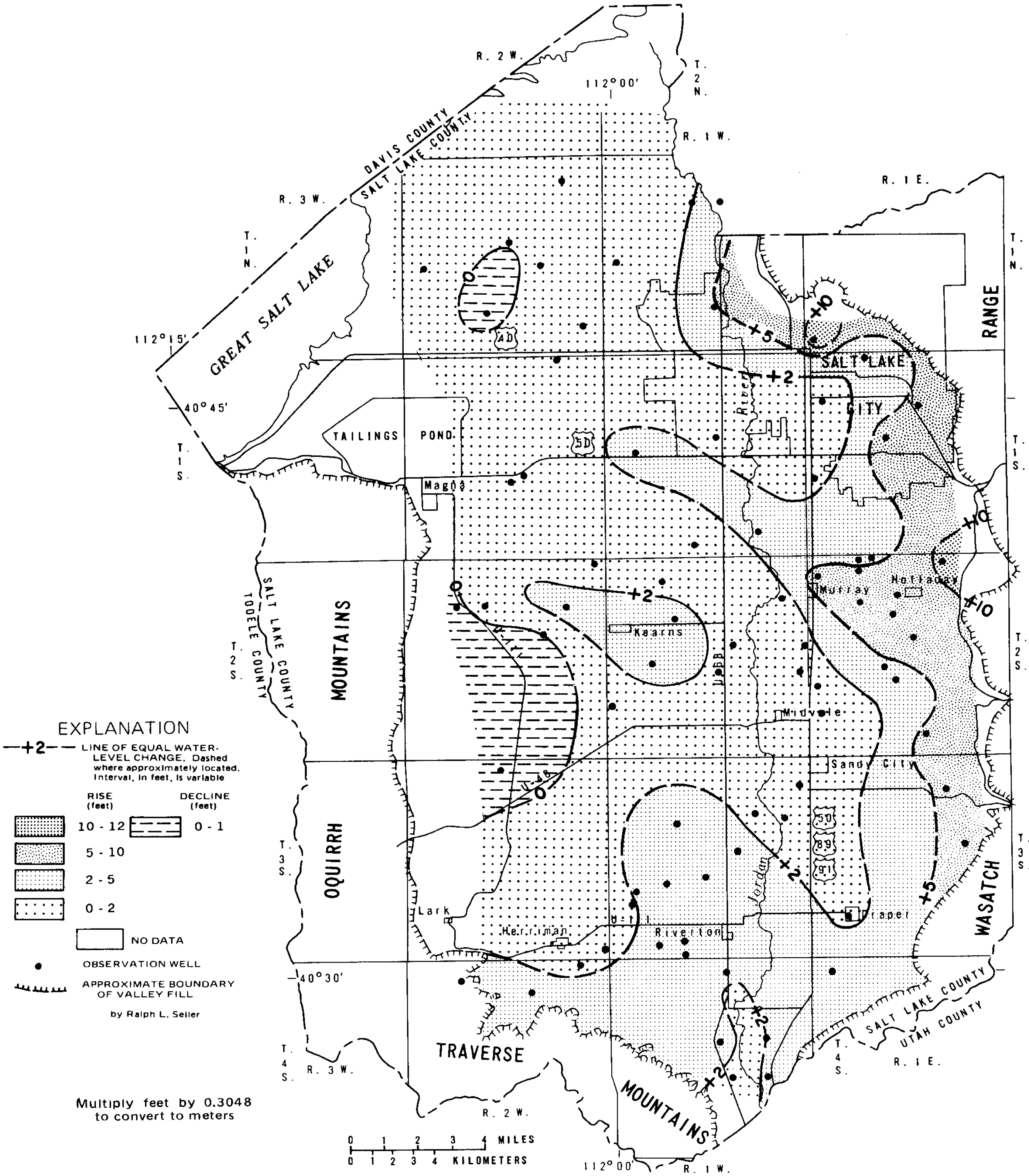


Figure 10.—Map of Salt Lake (Jordan) Valley showing change of water levels from February 1982 to February 1983.

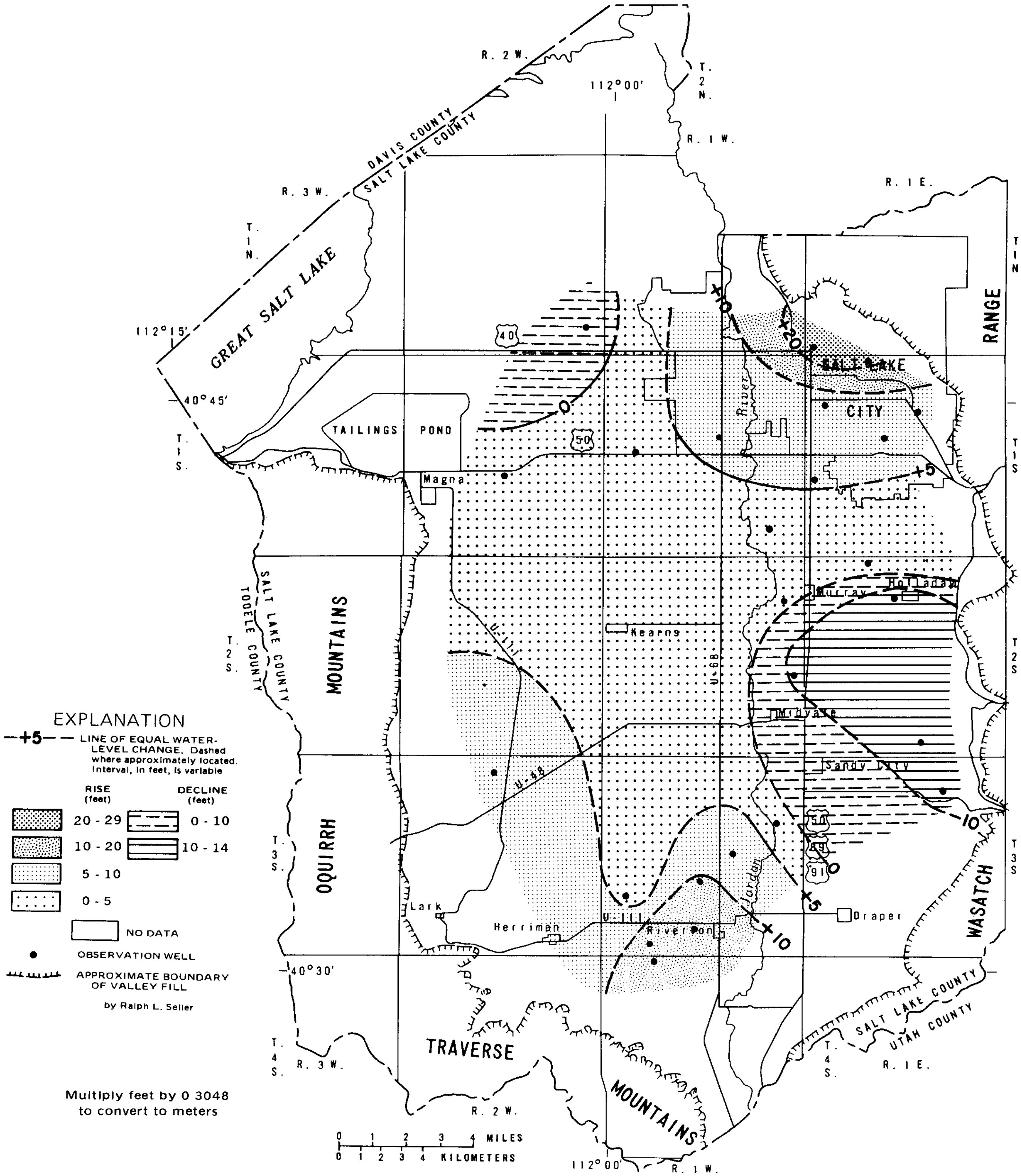


Figure 11.—Map of Salt Lake (Jordan) Valley showing change of water levels from January-March 1963 to February 1983.

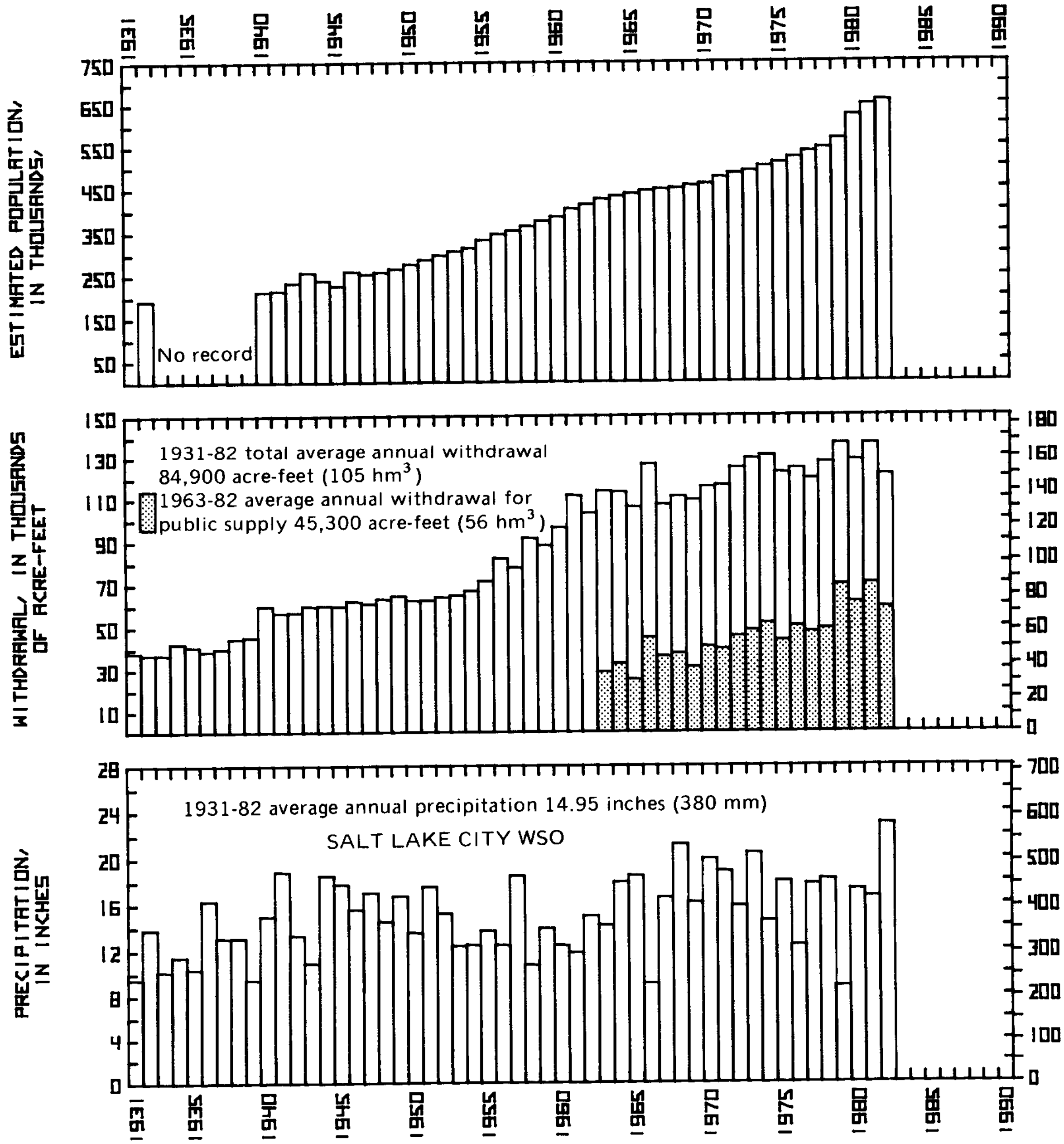


Figure 12.—Estimated population of Salt Lake County, total annual withdrawals from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City WSO (International Airport).

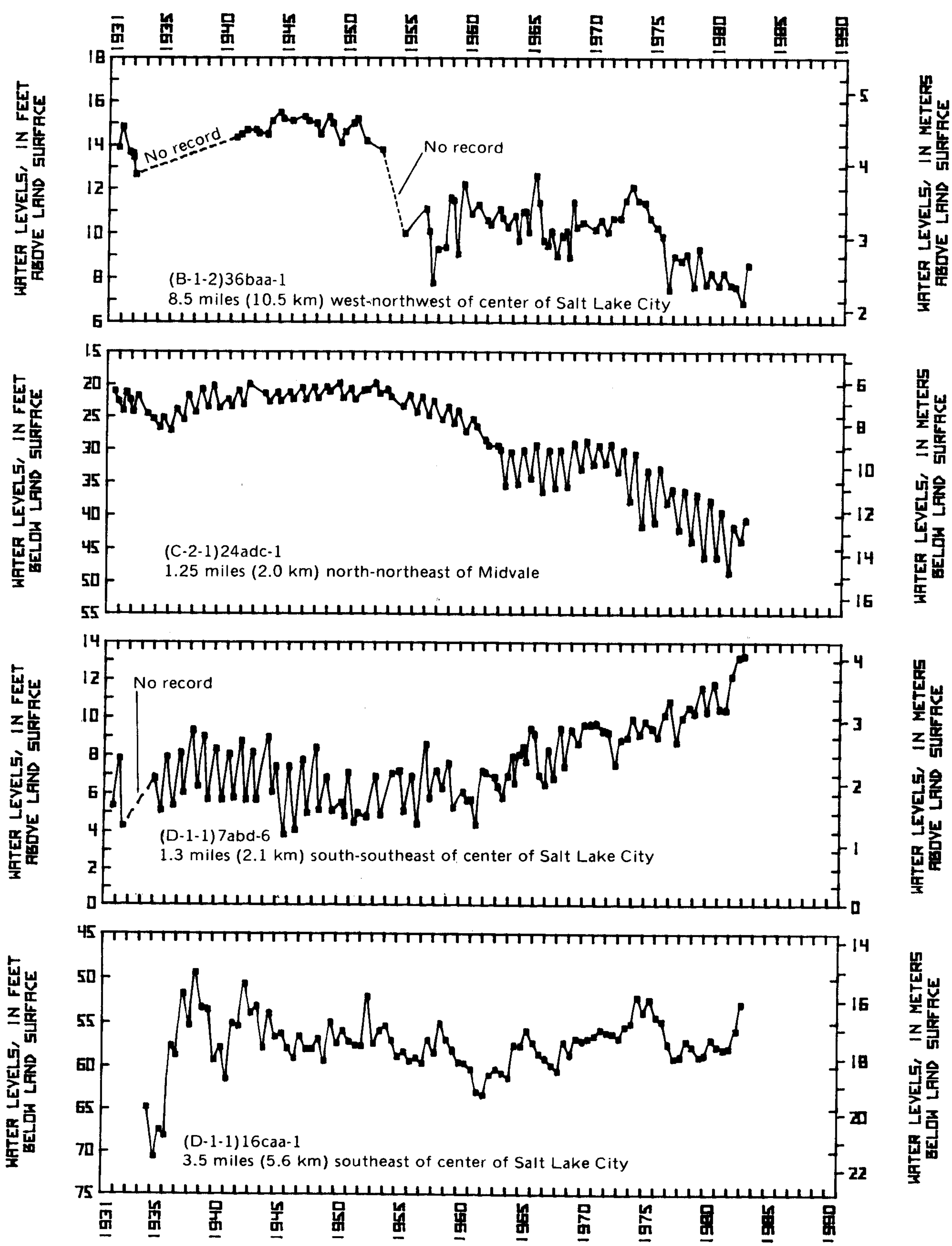


Figure 13.—Relation of water levels in selected wells in the Salt Lake (Jordan) Valley to cumulative departure from the average annual precipitation at Silver Lake Brighton.

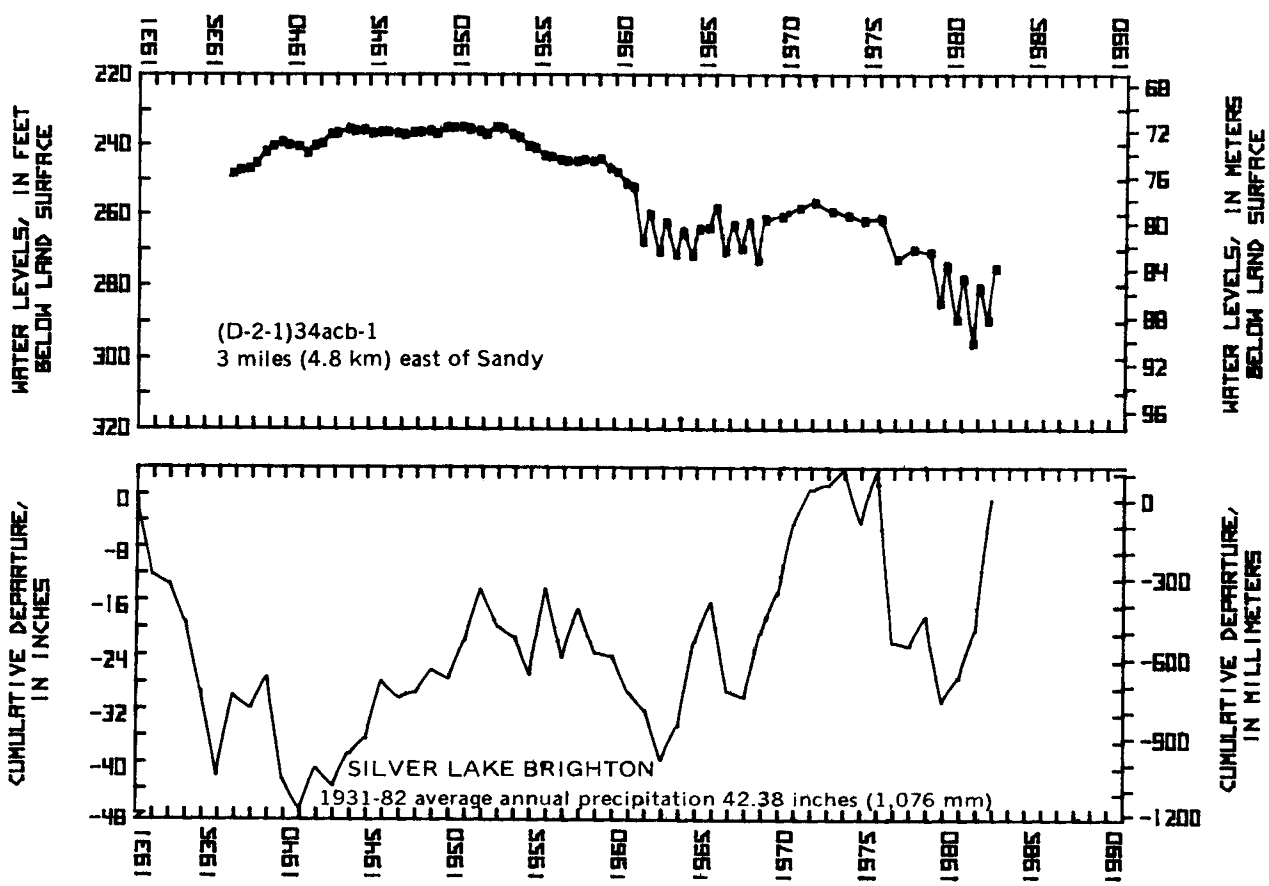


Figure 13.—Continued

TOOELE VALLEY

by Kevin Guttormson

Withdrawal of water from wells in Tooele Valley in 1982 was approximately 26,000 acre-feet (32 hm^3). This is 4,000 acre-feet (4.9 hm^3) less than both the 1981 withdrawal and the 1972-81 average annual withdrawal (table 2). The decrease was due to decreased withdrawals for irrigation and public supply.

Discharge from Fishing Creek, Sixmile Creek, Mill Pond, and Dunnes Pond Springs (fig. 14) was approximately 18,600 acre-feet (23 hm^3) which is 3,600 acre-feet (4.4 hm^3) more than that reported in 1981. About 2,100 acre-feet (2.6 hm^3) of the spring discharge was used for irrigation and stock in the valley. The remaining 16,500 acre-feet (20.3 hm^3) was diverted to Salt Lake (Jordan) Valley for industrial use.

Water levels rose less than 2 feet (0.6 m) from March 1982 to March 1983 in the major part of the valley (fig. 14). Rises of nearly 7 feet (2.1 m) were recorded near Grantsville. These rises may be attributed to above average precipitation and the decline in ground-water withdrawal in 1982. Water-level declines of up to 5 feet (1.5 m) occurred north of Tooele. These declines may be due to continued large withdrawals for public supply in that general area and also a decrease in water discharged to the valley from mine workings in the Oquirrh Mountains. The mine discharge had previously been a significant source of recharge to the valley ground-water reservoir.

Water levels rose from March 1963 to March 1983 in most of Tooele Valley (fig. 15). Rises generally were less than 7 feet (2.1 m); however, a rise of nearly 9 feet (2.7 m) was recorded west of Erda. The rises may be due to increased recharge to the valley ground-water reservoir as a result of generally above average precipitation. Water-level declines generally were less than 2 feet (0.6 m) in the western part of the valley. Declines of between 2 and 5 feet (0.6 and 1.5 m), however, occurred north and northeast of Grantsville. These declines probably were due to localized large ground-water withdrawal.

The relation of water levels in selected observation wells, precipitation at Tooele, and annual withdrawals from wells is shown in figure 16. Water levels rose in all four observation wells. Precipitation at Tooele in 1982 was 25.37 inches (644 mm), 8.71 inches (221 mm) above the 1936-82 average annual precipitation.

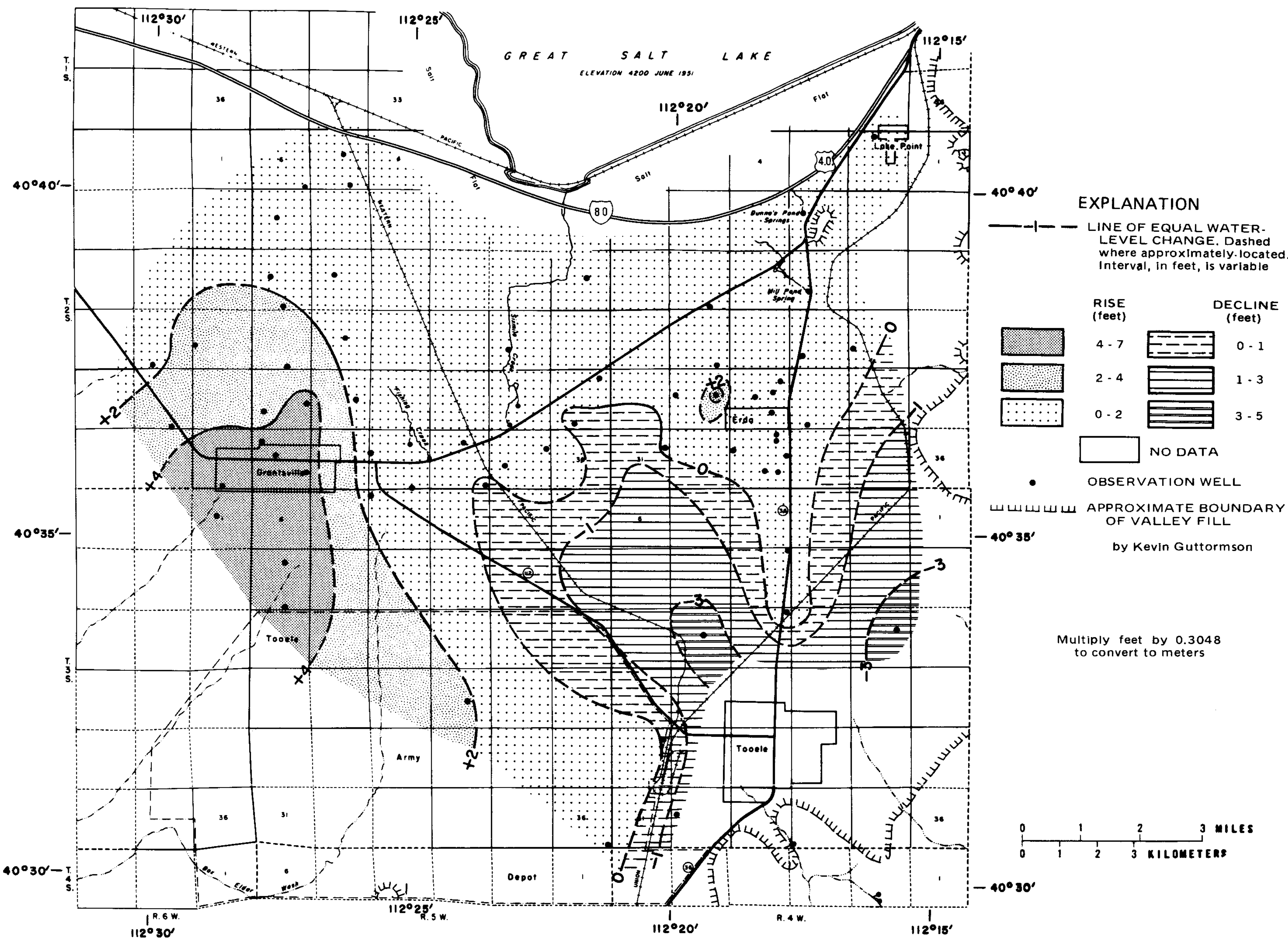


Figure 14.—Map of Tooele Valley showing change of water levels in artesian aquifers from March 1982 to March 1983.

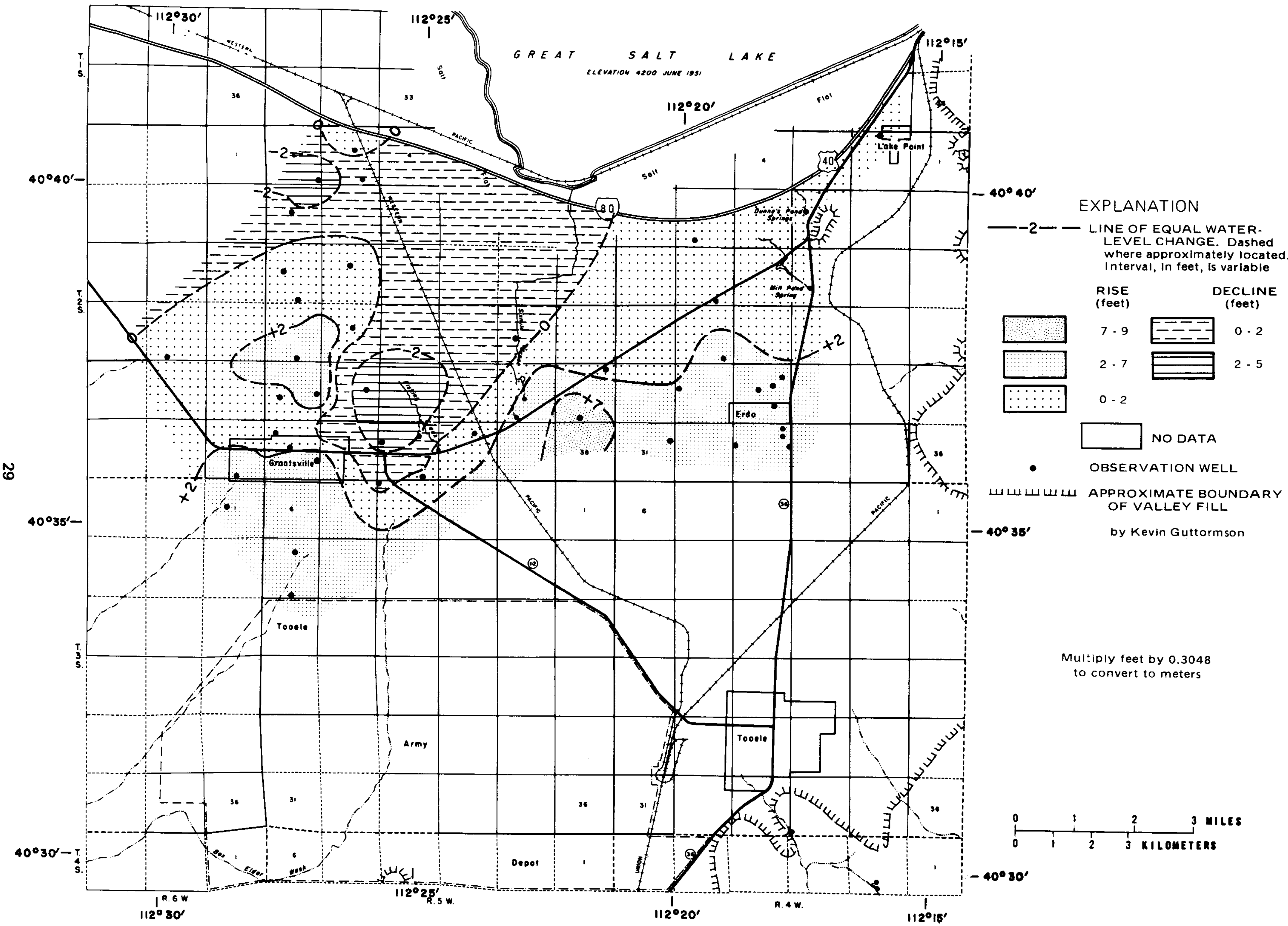


Figure 15.—Map of Tooele Valley showing change of water levels in artesian aquifers from March 1963 to March 1983.

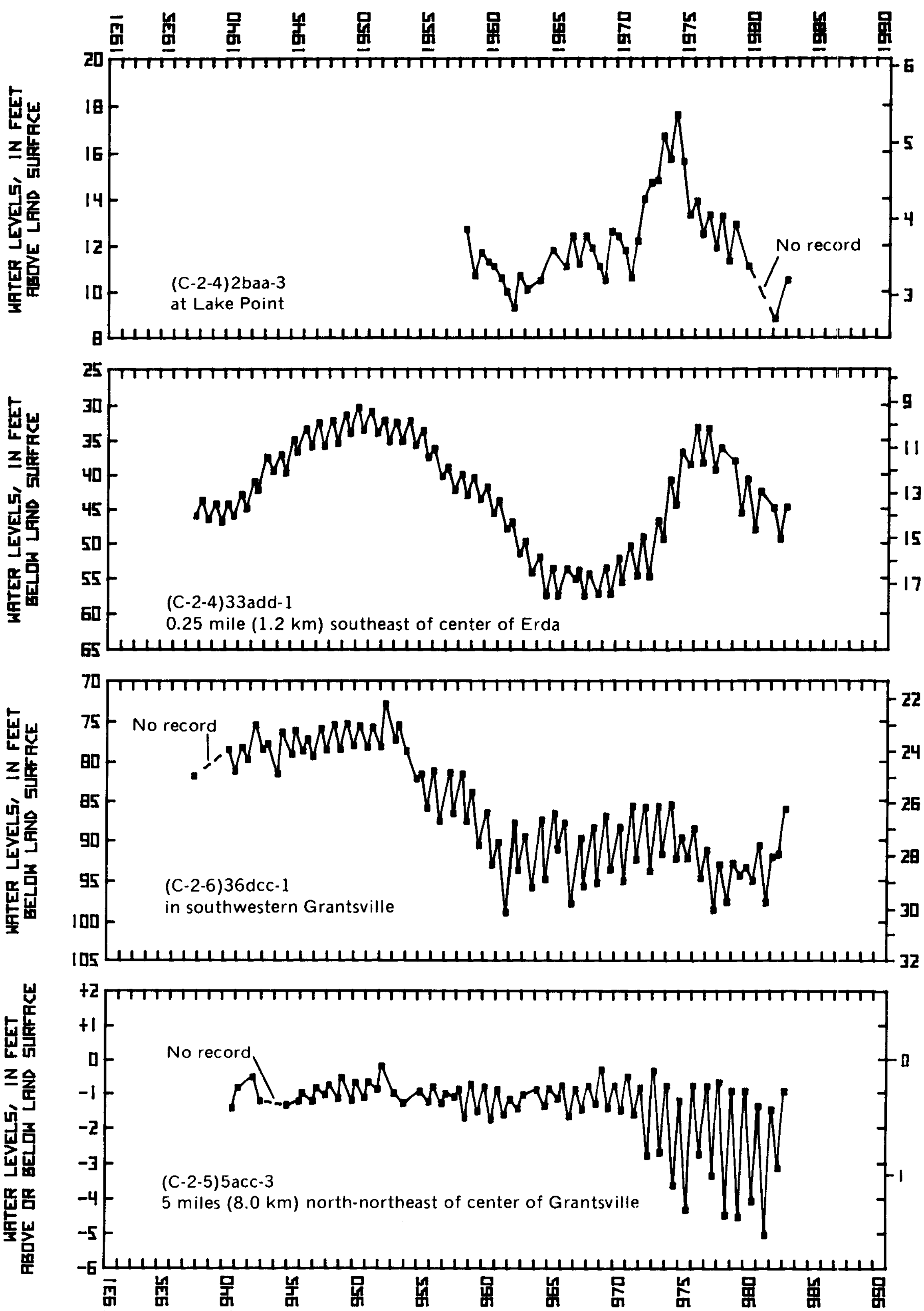


Figure 16.—Relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele and to annual withdrawals from wells.

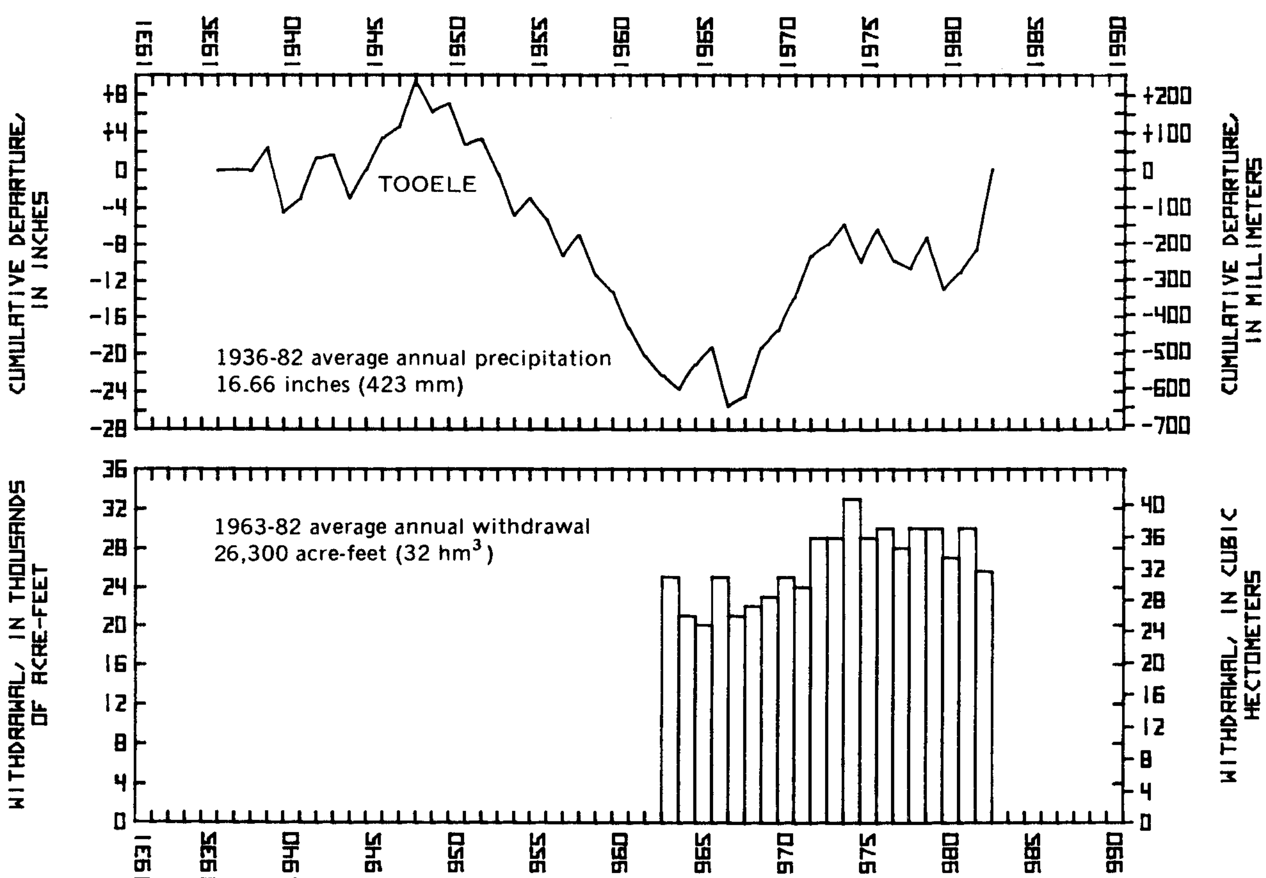


Figure 16.—Continued

UTAH AND GOSHEN VALLEYS

by Cynthia L. Appel

Withdrawal of water from wells in Utah and Goshen Valleys in 1982 was about 86,000 acre-feet (106 hm^3). This was 15,000 acre-feet (18 hm^3) less than in 1981 and 16,000 acre-feet (20 hm^3) less than the 1972-81 average annual (table 2). Withdrawal in Utah Valley was 70,700 acre-feet (87 hm^3) in 1982, or 11,900 acre-feet (15 hm^3) less than in 1981. Withdrawal in Goshen Valley was 15,600 acre-feet (19 hm^3) in 1982, or 3,200 acre-feet (3.9 hm^3) less than in 1981. The decrease in ground-water withdrawal mainly was due to a decrease for irrigation and public supply. Withdrawal for irrigation in Utah and Goshen Valleys decreased by 5,200 and 3,200 acre-feet (6.4 and 3.9 hm^3), respectively.

Water levels throughout Utah and Goshen Valleys rose from March 1982 to March 1983 except in the water-table aquifer at the southern end of Goshen Valley (figs. 17 to 20). The rises were due to above average precipitation and the decrease in ground-water withdrawal.

Water levels generally rose in Utah Valley from March-April 1963 to March 1983 (figs. 21 to 24). The rises probably were due to increased recharge to the ground-water reservoir as a result of above average precipitation and streamflow in 1982. In the water-table aquifer of Goshen Valley, water levels generally declined during the same period. The declines probably are due to continual large withdrawals for irrigation.

The relation of water levels in selected observation wells to precipitation, total annual withdrawals from wells, annual withdrawals for public supply, and estimated population of Utah County is shown in figure 25.

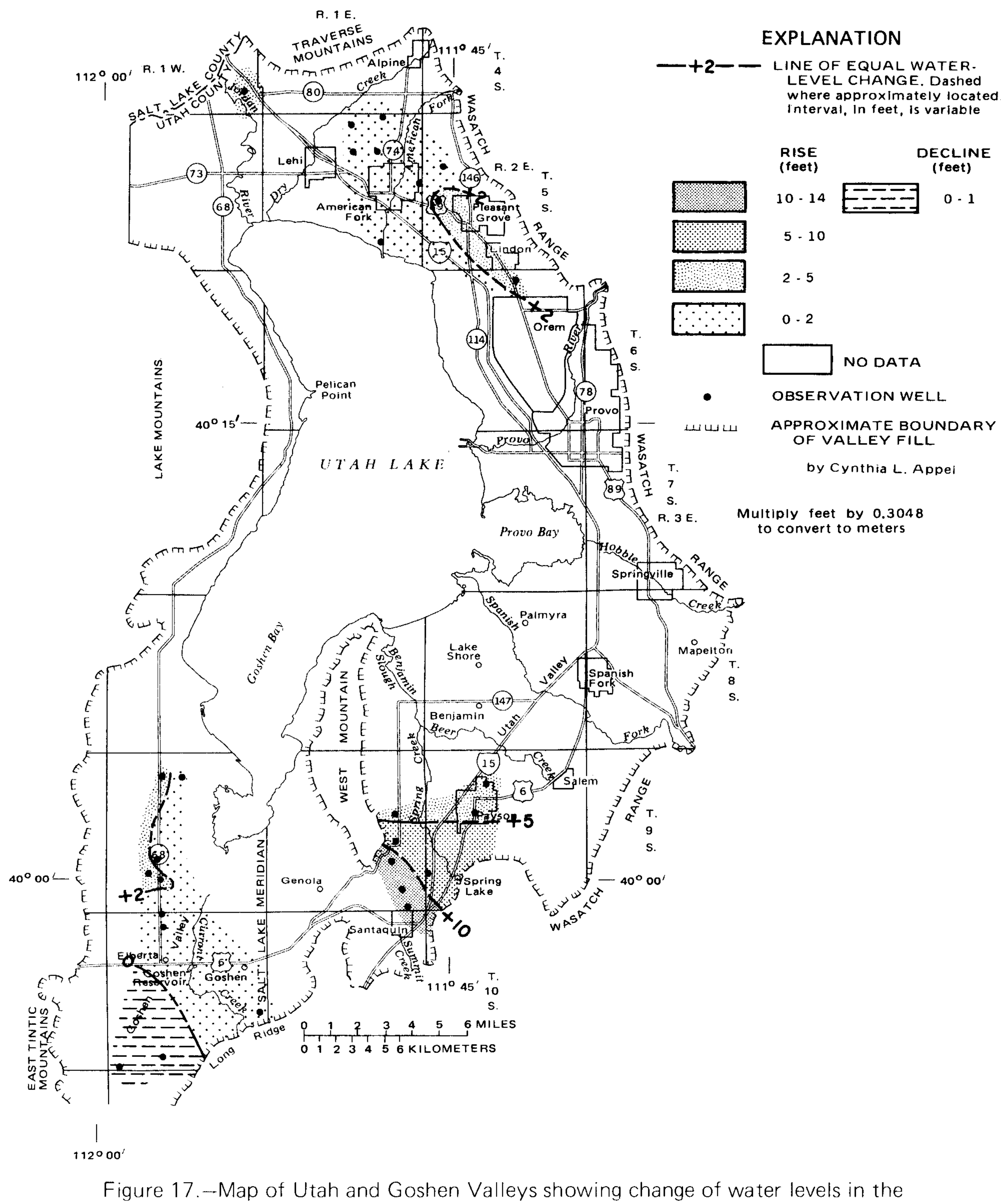


Figure 17.—Map of Utah and Goshen Valleys showing change of water levels in the water-table aquifers from March 1982 to March 1983.

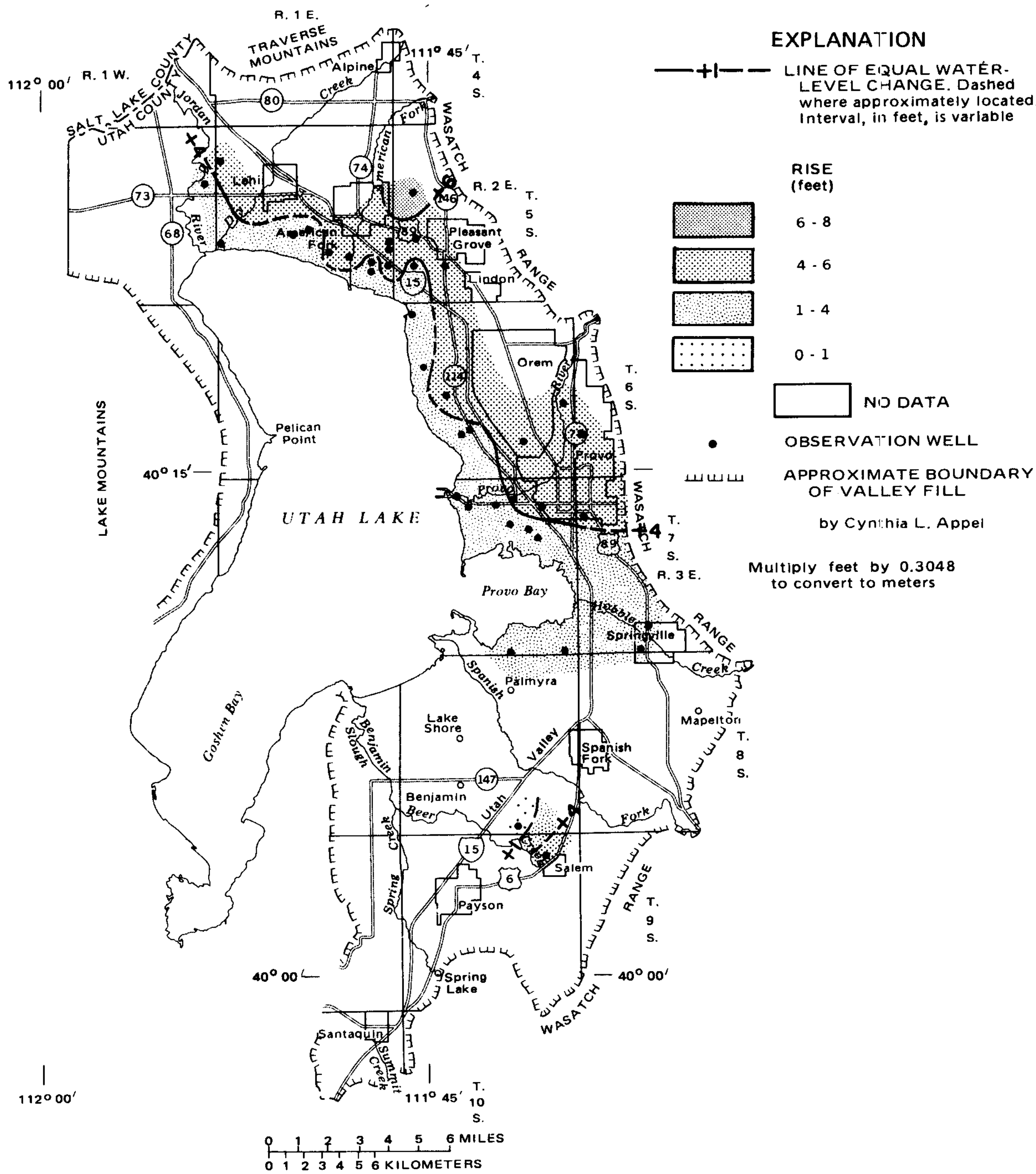


Figure 18.—Map of Utah Valley showing change of water levels in the shallow artesian aquifer in rocks of Pleistocene age from March 1982 to March 1983.

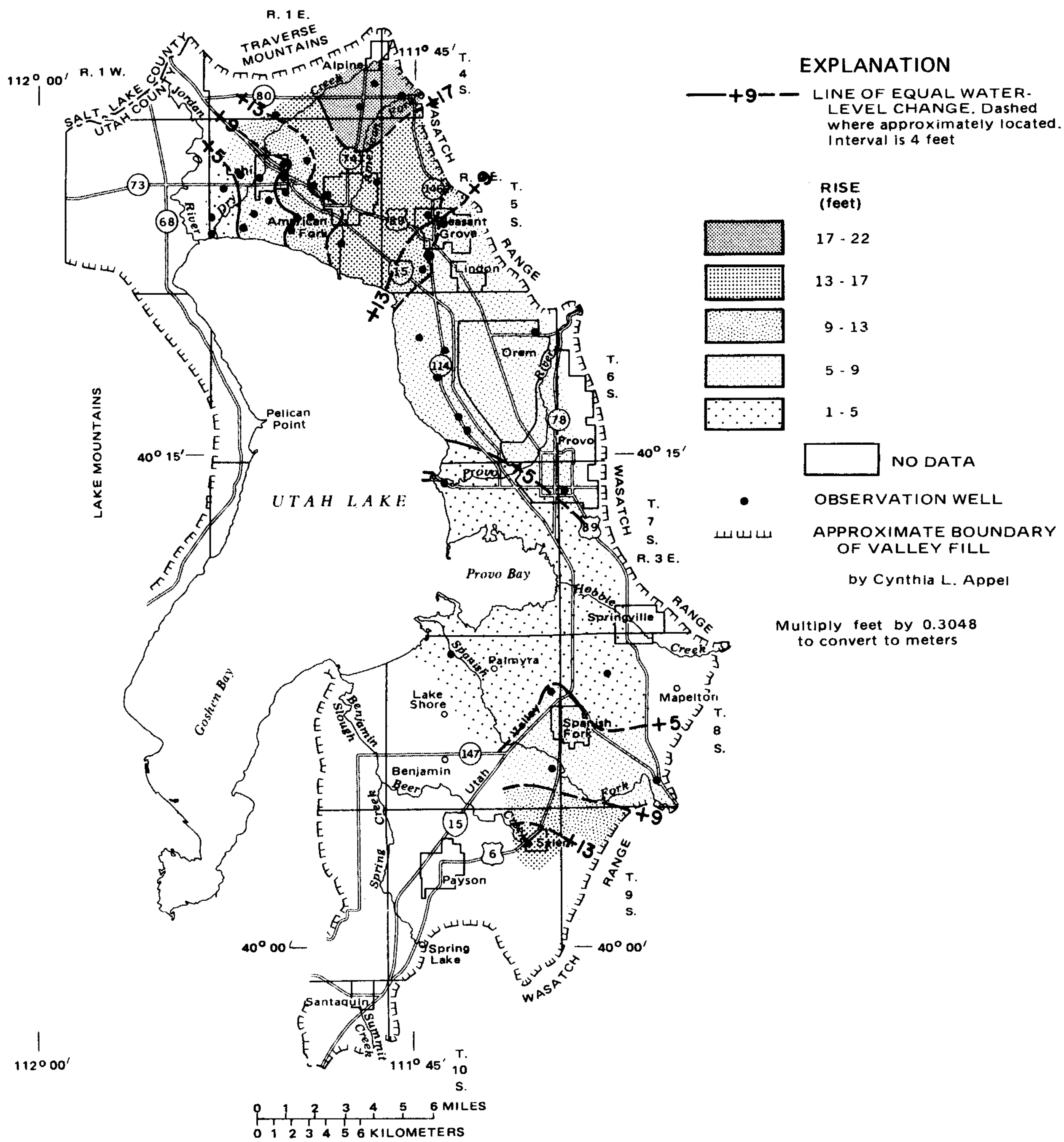


Figure 19.—Map of Utah Valley showing change of water levels in the deep artesian aquifer in rocks of Pleistocene age from March 1982 to March 1983.

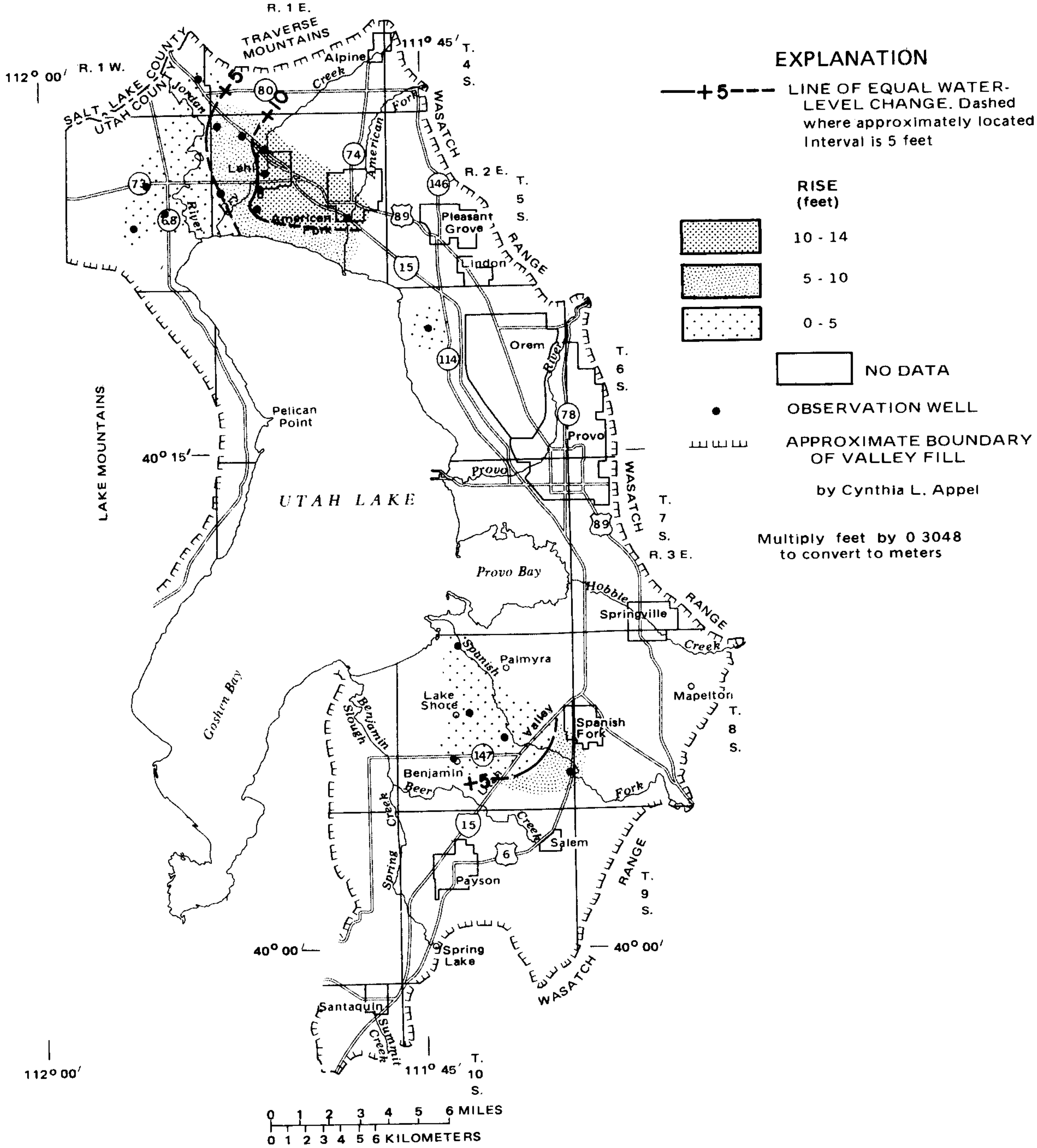


Figure 20.—Map of Utah Valley showing change of water levels in the artesian aquifer in rocks of Tertiary (?) age from March 1982 to March 1983.

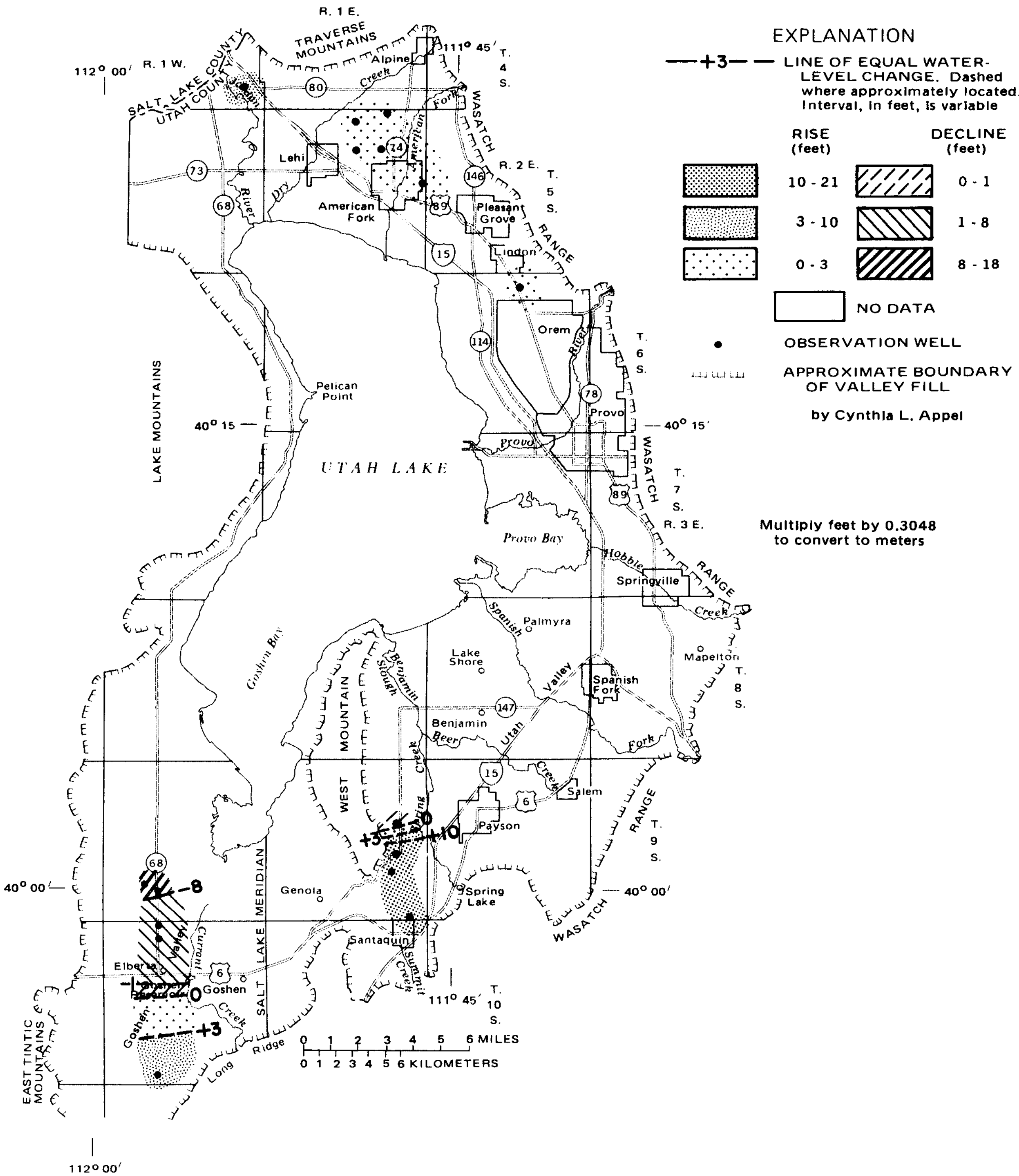


Figure 21.—Map of Utah and Goshen Valleys showing change of water levels in the water-table aquifers from March-April 1963 to March 1983.

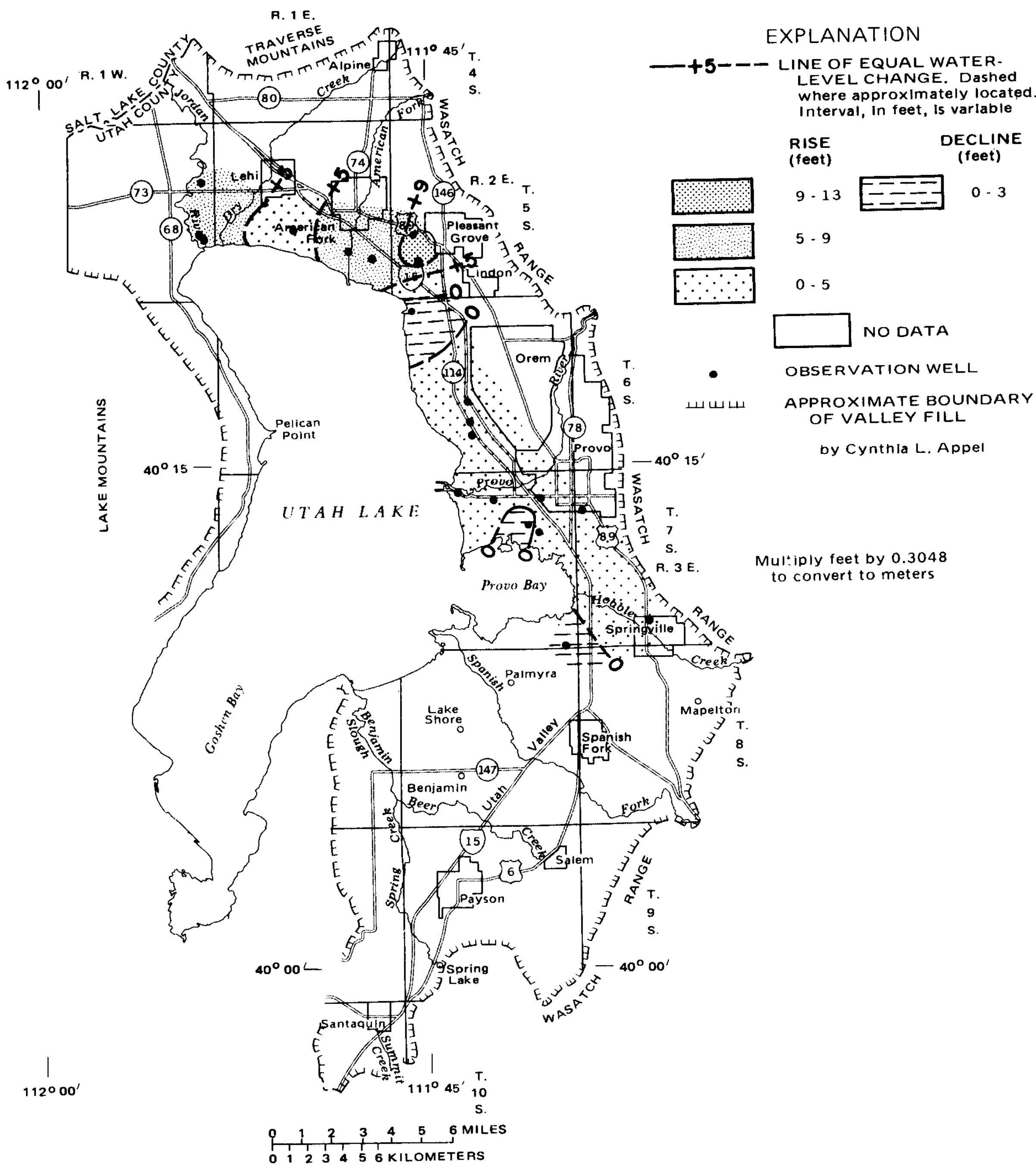


Figure 22.—Map of Utah Valley showing change of water levels in the shallow artesian aquifer in rocks of Pleistocene age from March-April 1963 to March 1983.

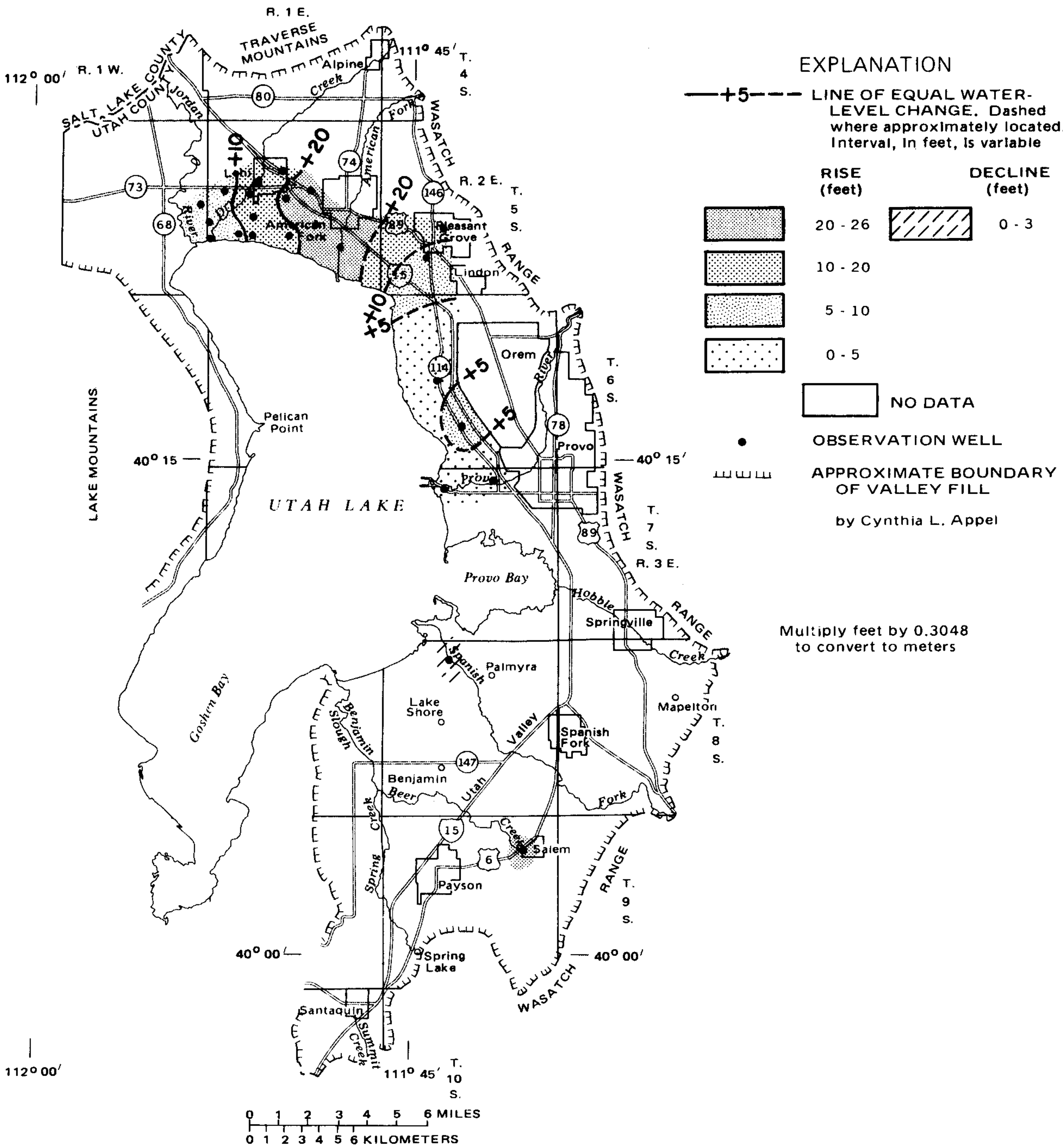


Figure 23.—Map of Utah Valley showing change of water levels in the deep artesian aquifer in rocks of Pleistocene age from March 1963 to March 1983.

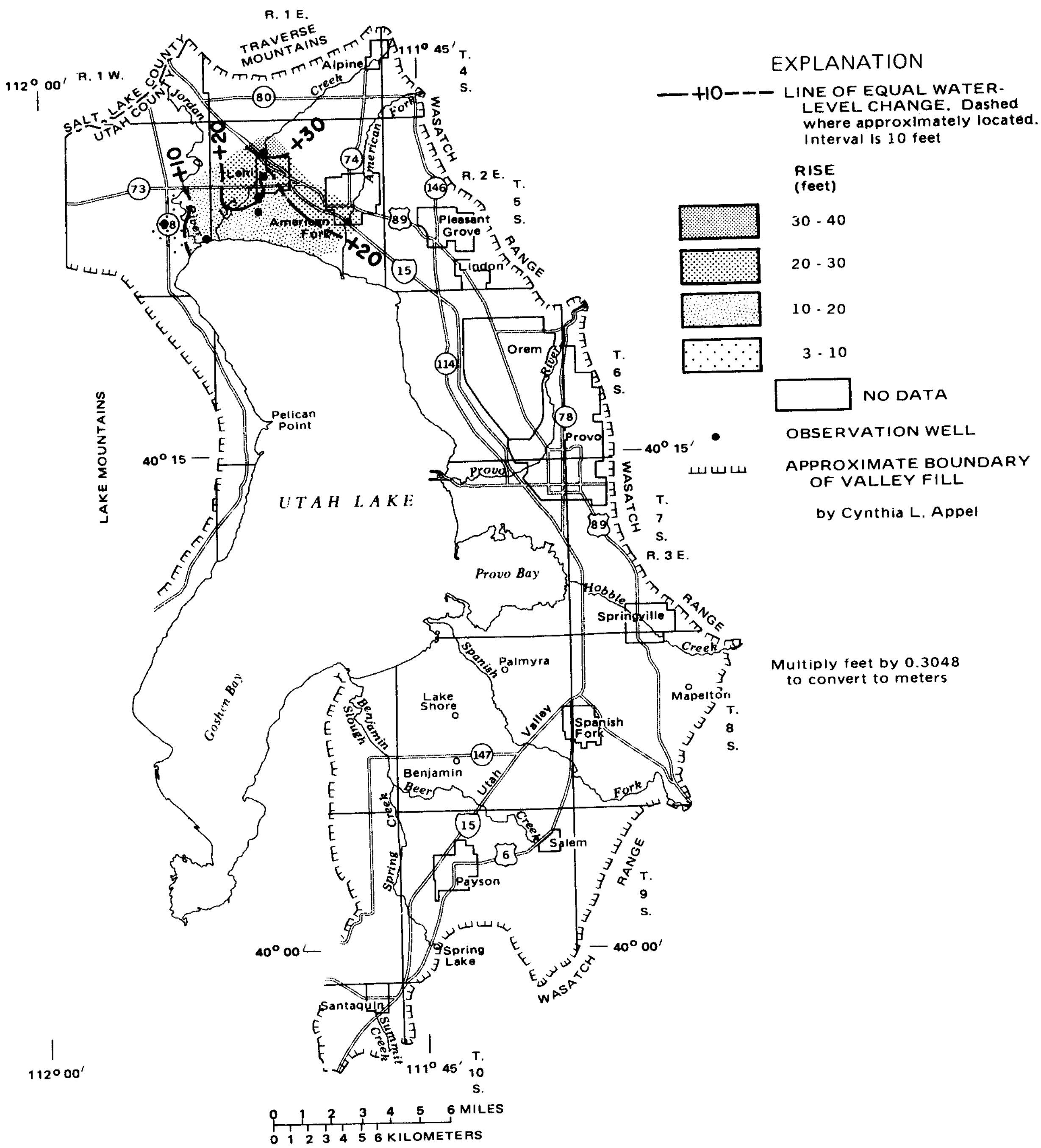


Figure 24.—Map of Utah Valley showing change of water levels in the artesian aquifer in rocks of Tertiary (?) age from March 1963 to March 1983.

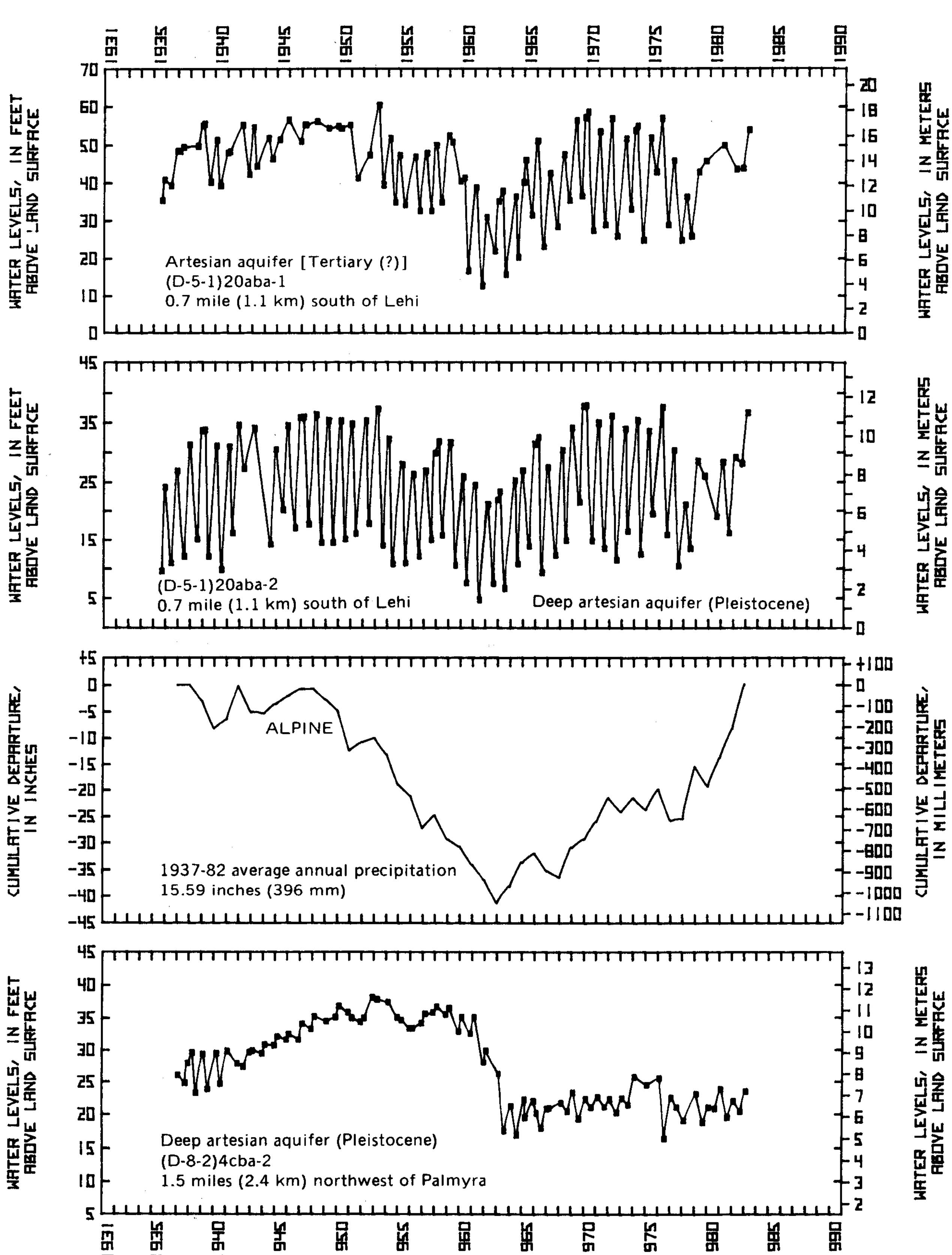


Figure 25.—Relation of water levels in selected wells to cumulative departure from the average annual precipitation at Alpine and Spanish Fork Powerhouse, and total annual withdrawals from wells and annual withdrawals for public supply in Utah and Goshen Valleys, and estimated population of Utah County.

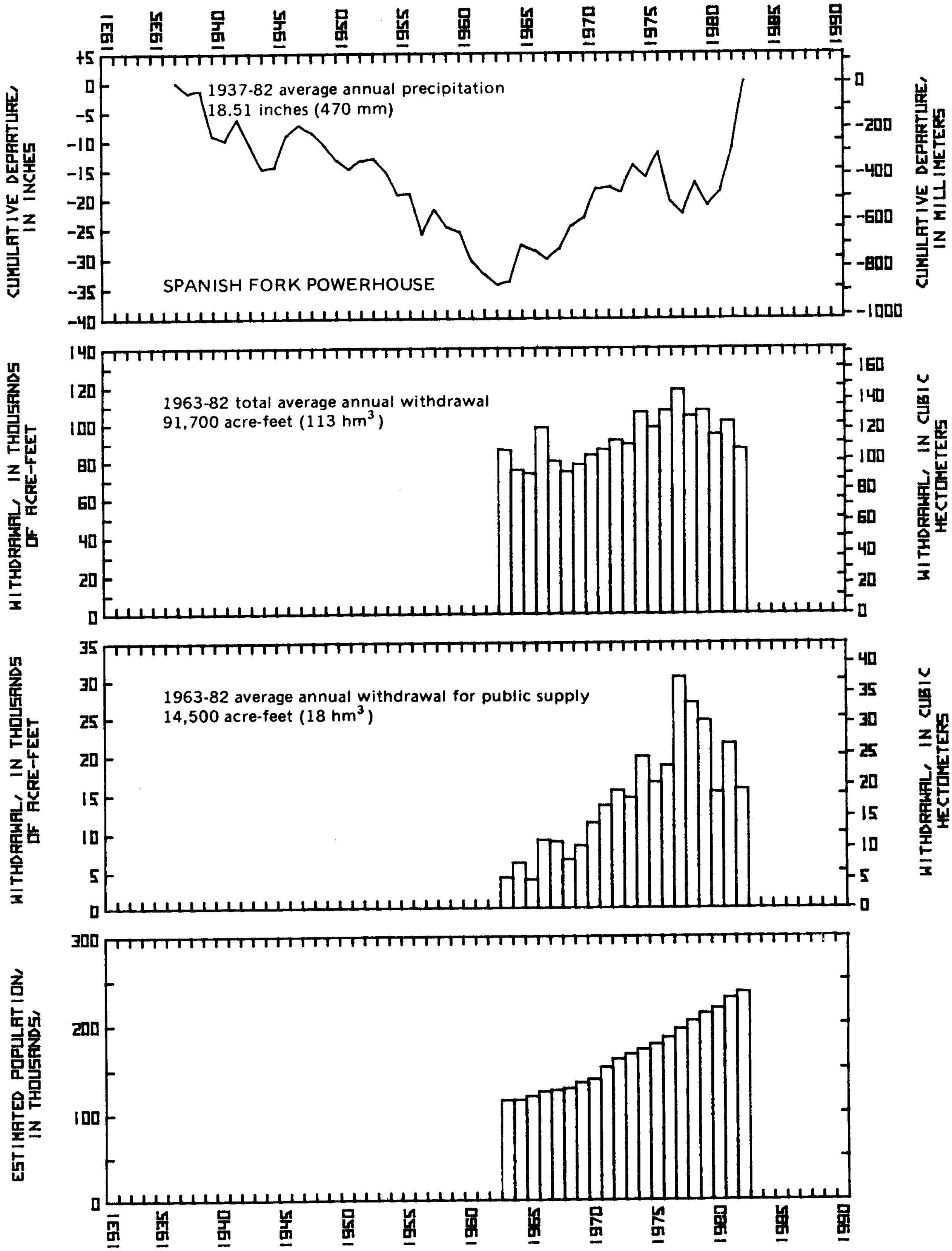


Figure 25.—Continued

JUAB VALLEY

by V. L. Jensen

Withdrawal of water from wells in Juab Valley during 1982 was about 16,000 acre-feet (20 hm^3). This was 5,000 acre-feet (6.2 hm^3) less than reported for 1981 and 8,000 acre-feet (9.9 hm^3) less than the 1972-81 average annual withdrawal (table 2). The decrease in withdrawal was due to the increased amount of surface water available for irrigation.

Water levels rose throughout the valley from March 1982 to March 1983 (fig. 26). The largest rises of nearly 8 feet (2.4 m) were in the Nephi area and east of Mount Nebo Reservoir. The rises probably were due to above average precipitation and decreased withdrawal from wells.

Water levels were higher in March 1983 than in March 1963 in most of Juab Valley (fig. 27). Rises of more than 20 feet (6.1 m) occurred in the Nephi and Levan areas. The rises probably are due to increased recharge to the ground-water reservoir as a result of a net increase in precipitation. A decline of less than 1 foot (0.3 m) was recorded southwest of Levan.

The relation of water levels in two selected observation wells, annual withdrawals from wells, and cumulative departure from the 1935-82 average annual precipitation at Nephi is shown in figure 28. Precipitation at Nephi during 1982 was 22.23 inches (565 mm) 8.30 inches (211 mm) above the 1935-82 average annual precipitation.

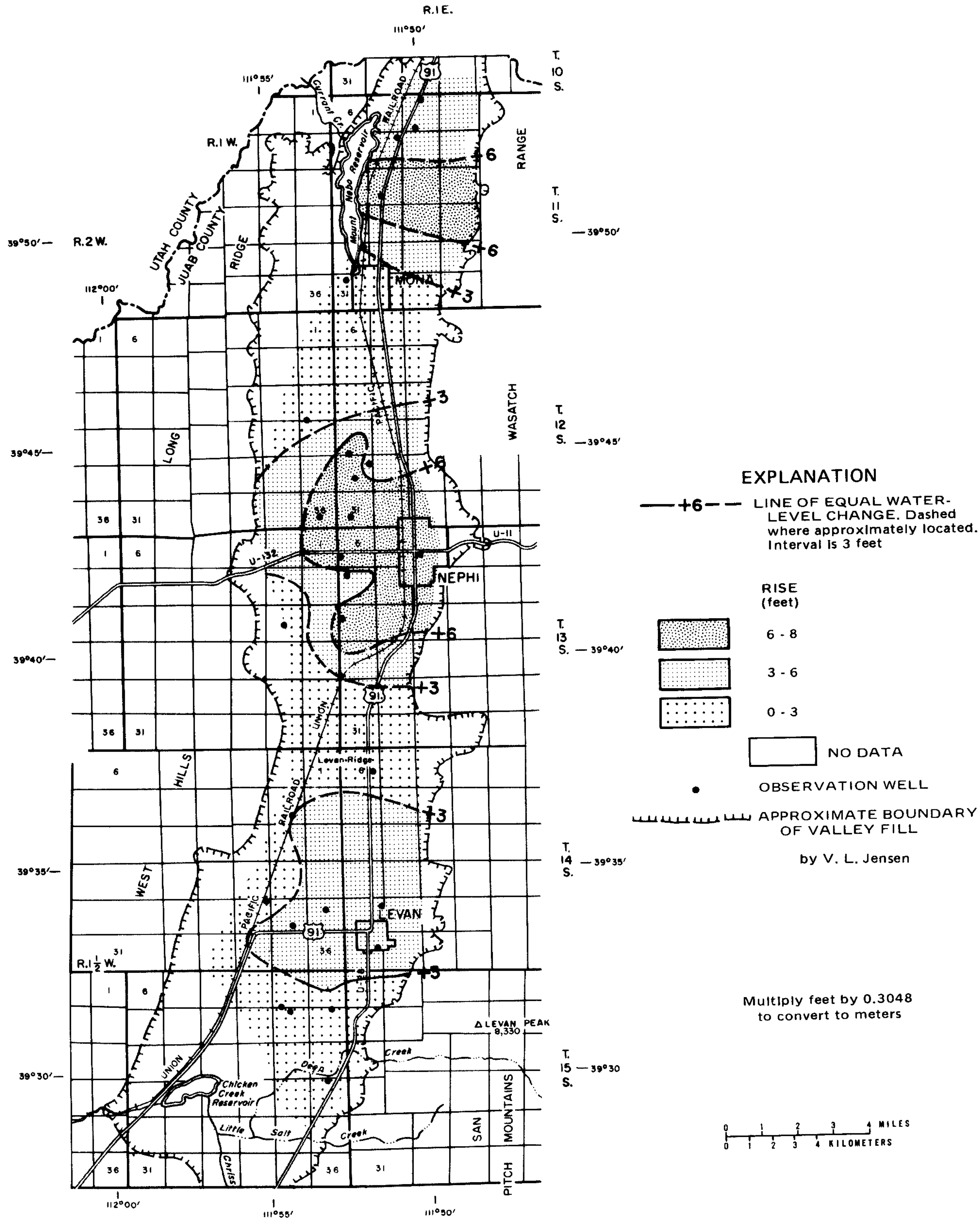


Figure 26.—Map of Juab Valley showing change of water levels from March 1982 to March 1983.

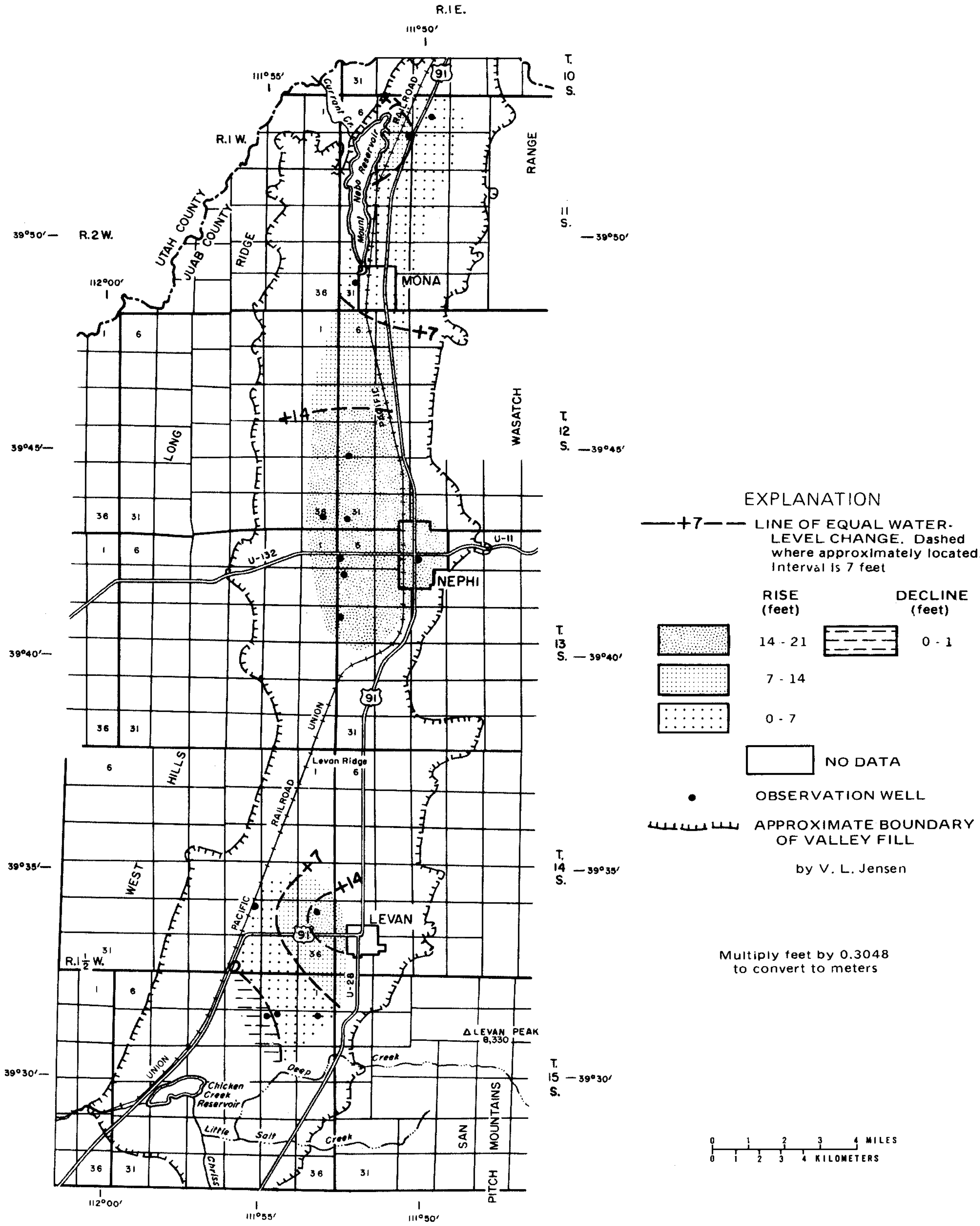


Figure 27.—Map of Juab Valley showing change of water levels from March 1963 to March 1983.

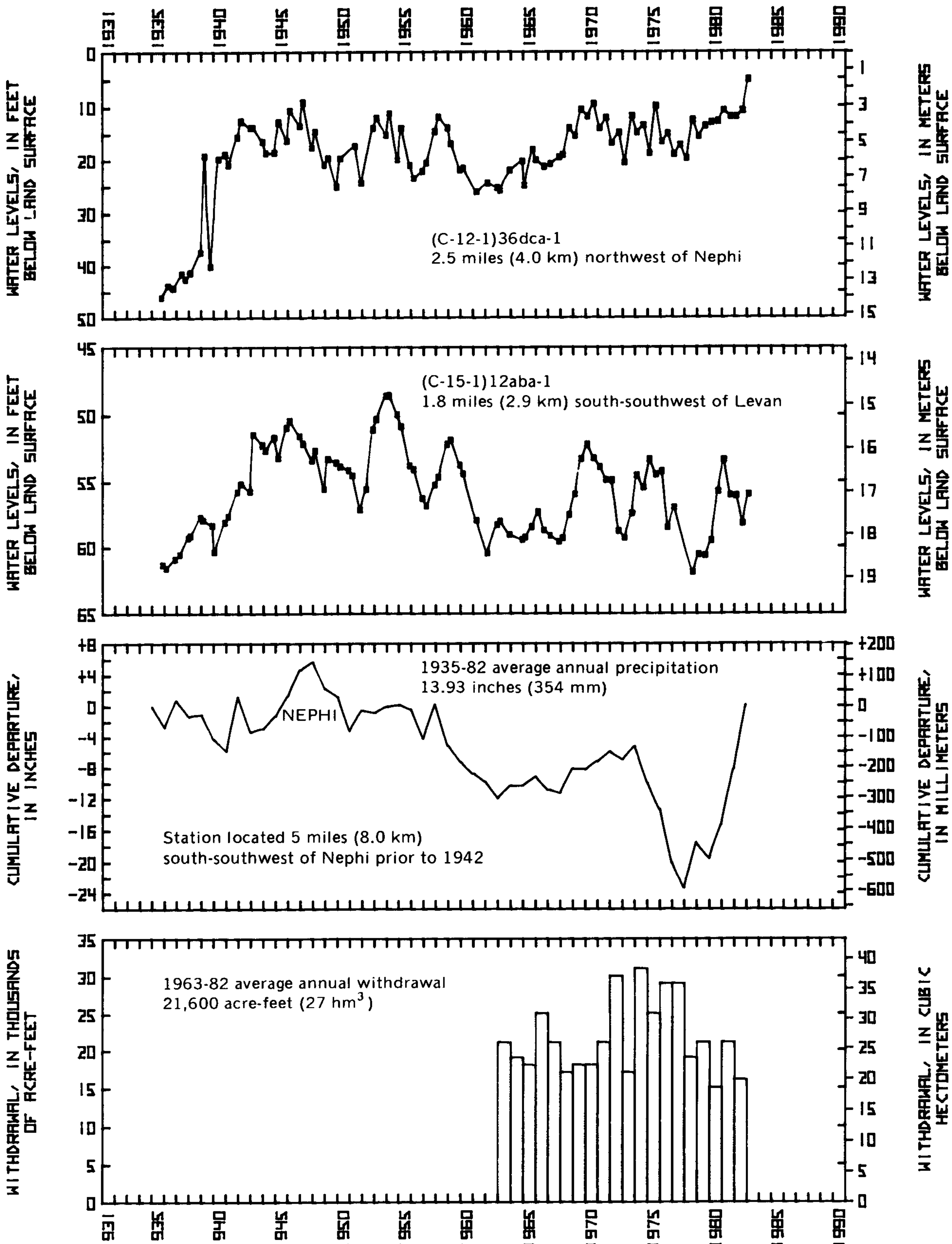


Figure 28.—Relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi and to annual withdrawals from wells.

SEVIER DESERT

by Michael Enright

Withdrawal of water from wells in the Sevier Desert in 1982 was about 16,000 acre-feet (20 hm^3). This was 2,000 acre-feet (2.5 hm^3) less than was reported for 1981 and about 15,000 acre-feet (18 hm^3) less than the 1972-81 average annual withdrawal (table 2). The relatively small withdrawal during 1981-82 was due to the availability of above normal supplies of surface water for irrigation. During 1982, the Sevier River near Juab discharged 182,500 acre-feet (225 hm^3) (fig. 29). This was 12,300 acre-feet (15 hm^3) less than the 1981 discharge, but about 39,000 acre-feet (48 hm^3) more than the 1935-82 average annual discharge.

In those parts of the Sevier Desert where observation wells are located, water levels rose from March 1982 to March 1983 in more than 95 percent of the upper artesian aquifer and throughout the lower artesian aquifer (figs. 30 and 31). The largest observed water-level rise in the upper and lower artesian aquifers was nearly 9 feet (2.7 m) along the eastern edge of the Sevier Desert. These rises can be attributed to continued below average ground-water withdrawals and above average surface-water supplies for irrigation. The only observed water-level decline, less than 1 foot (0.3 m) was in the upper artesian aquifer in the southwest part of the Sevier Desert.

Changes in water levels in the upper and lower artesian aquifers from March 1963 to March 1983 are shown in figures 32 and 33. Declines in water levels generally occurred in both aquifers although some rises in the eastern and central parts of the Sevier Desert were recorded. Declines of nearly 16 feet (4.9 m) in the lower aquifer, and nearly 7 feet (2 m) in the upper aquifer occurred in the Delta City area. The declines may be due to continued localized ground-water withdrawals for municipal and irrigation use. Rises of nearly 6 feet (1.8 m) occurred in the upper and lower artesian aquifers in the eastern and central parts of the Sevier Desert. These rises may be the result of increased recharge from streamflow from the Canyon Mountains and decreased ground-water withdrawals during the last 3 years (fig. 29).

The long-term relation of precipitation at Oak City, discharge of the Sevier River near Juab, water levels in selected wells, and annual withdrawals from wells are shown in figure 29. Precipitation at Oak City in 1982 was 18.26 inches (464 mm), 5.71 inches (145 mm) above the 1935-82 average annual precipitation.

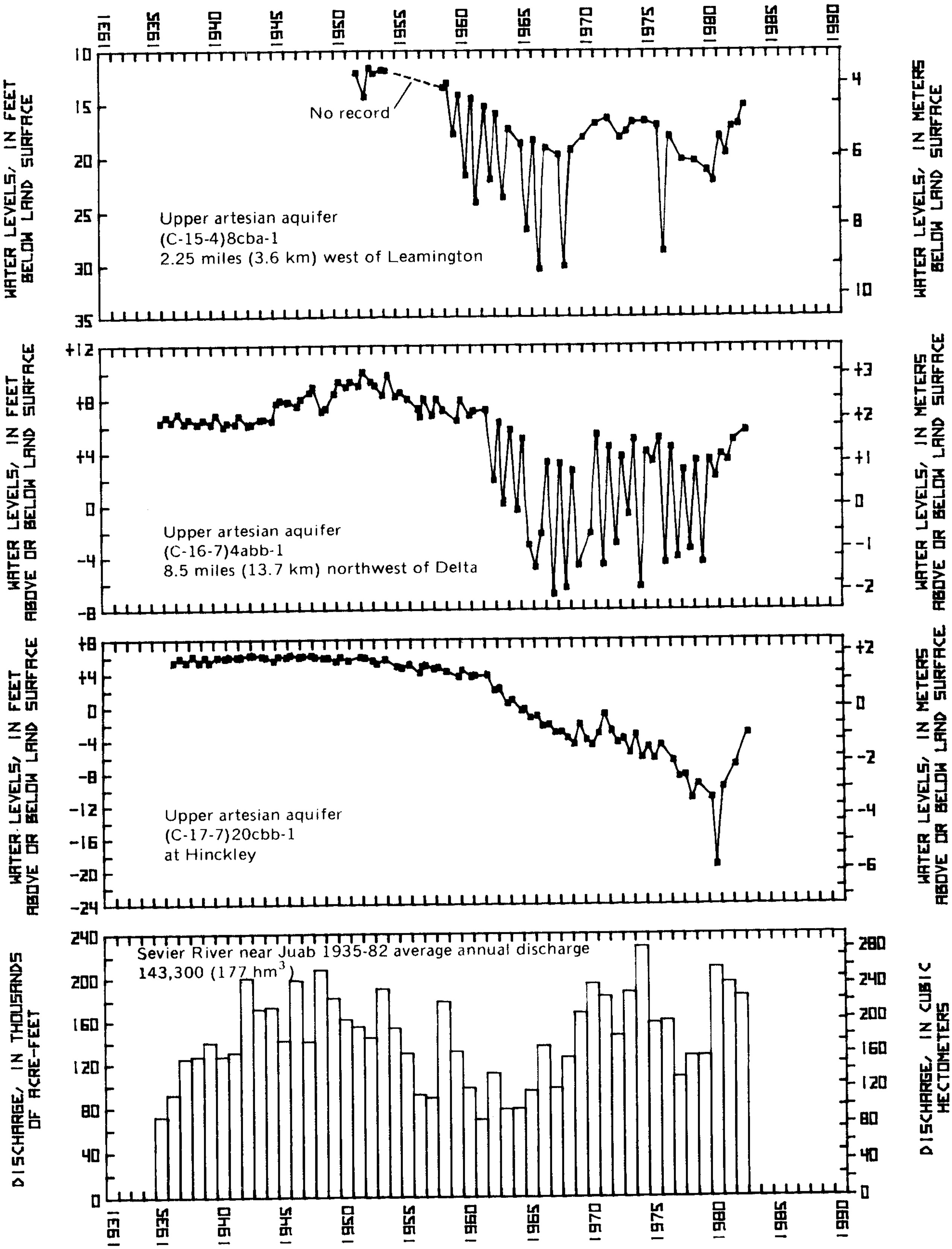


Figure 29.—Relation of water levels in selected wells in the Sevier Desert to discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, and to annual withdrawals from wells.

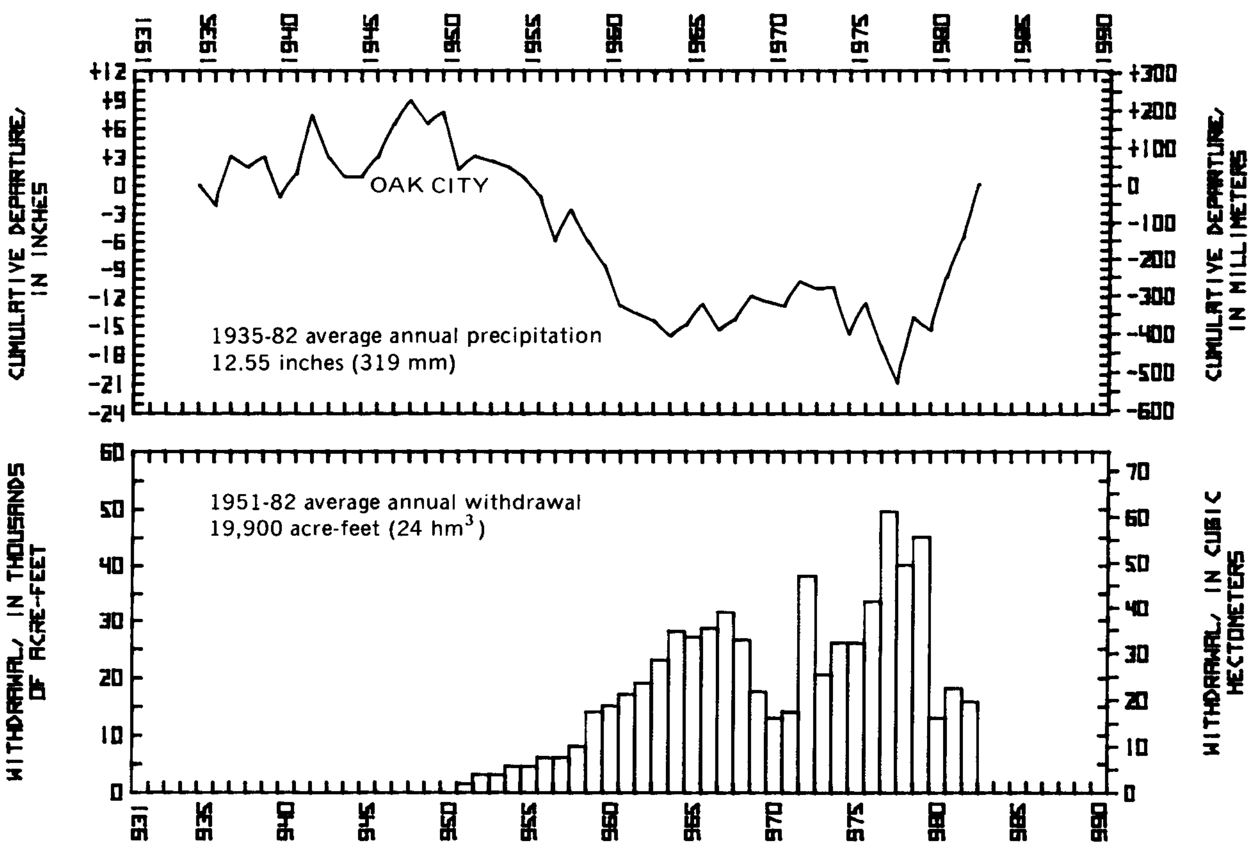


Figure 29.—Continued

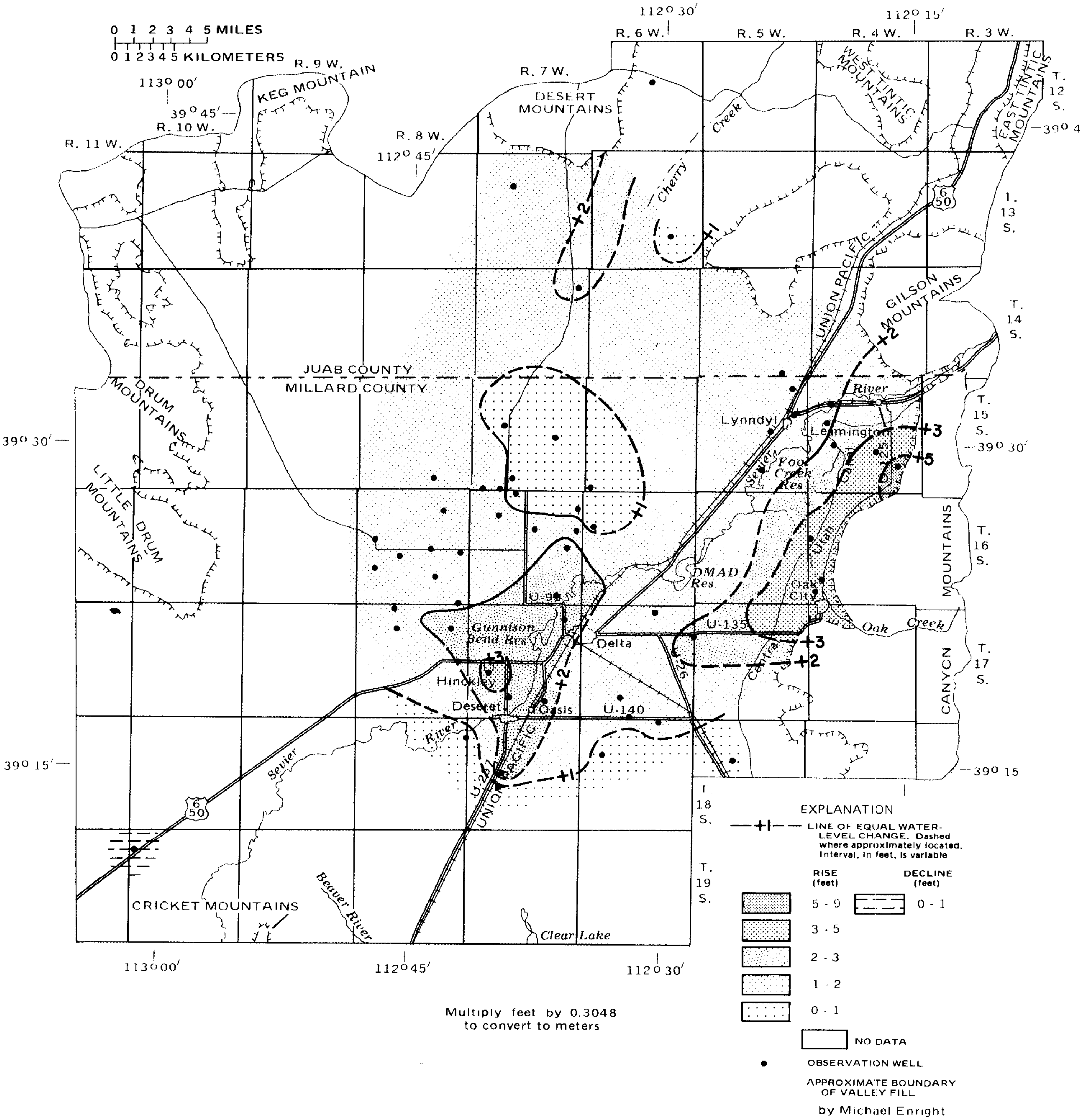


Figure 30.—Map of part of the Sevier Desert showing change of water levels in the upper artesian aquifer from March 1982 to March 1983.

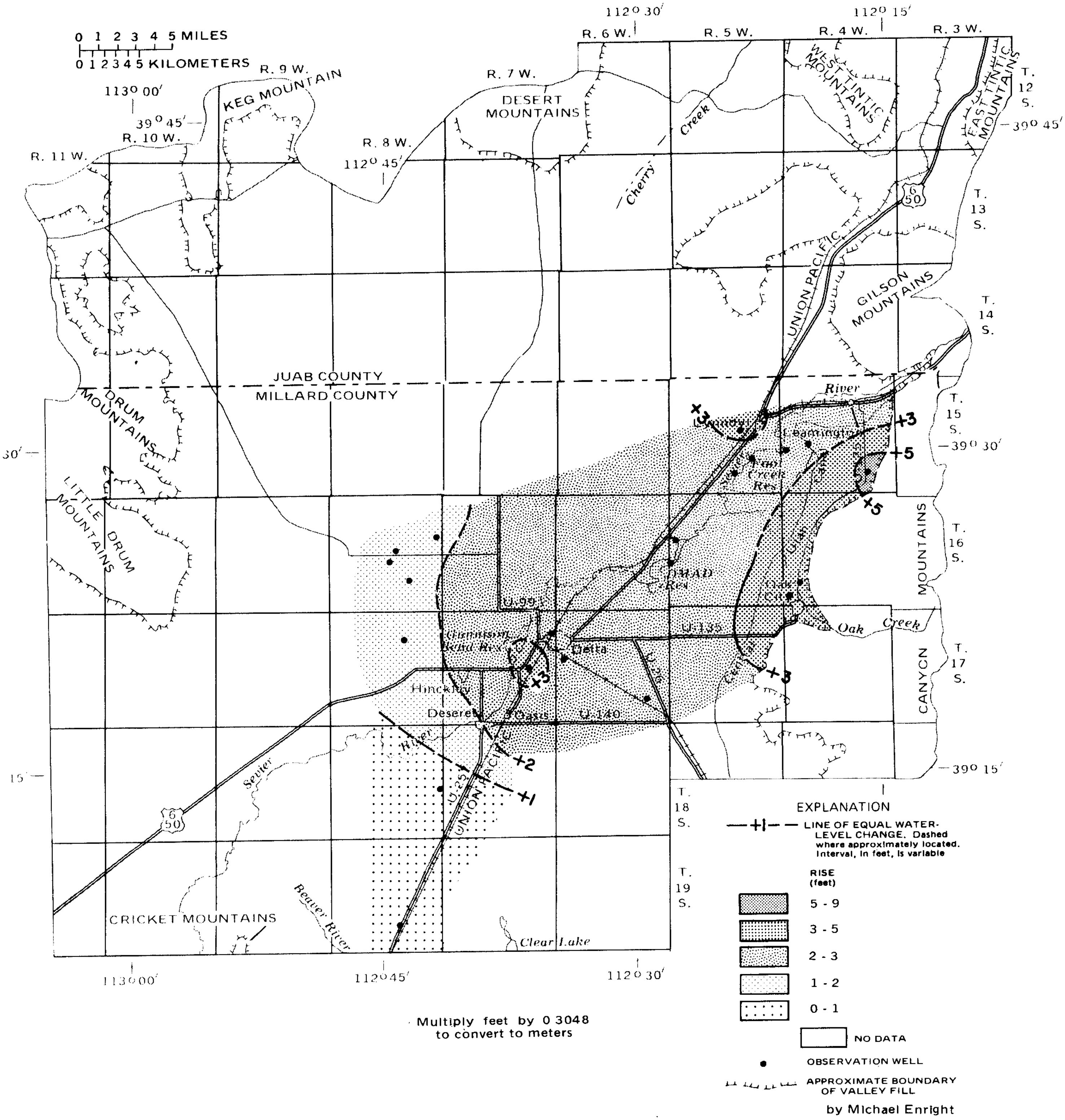


Figure 31.—Map of part of the Sevier Desert showing change of water levels in the lower artesian aquifer from March 1982 to March 1983.

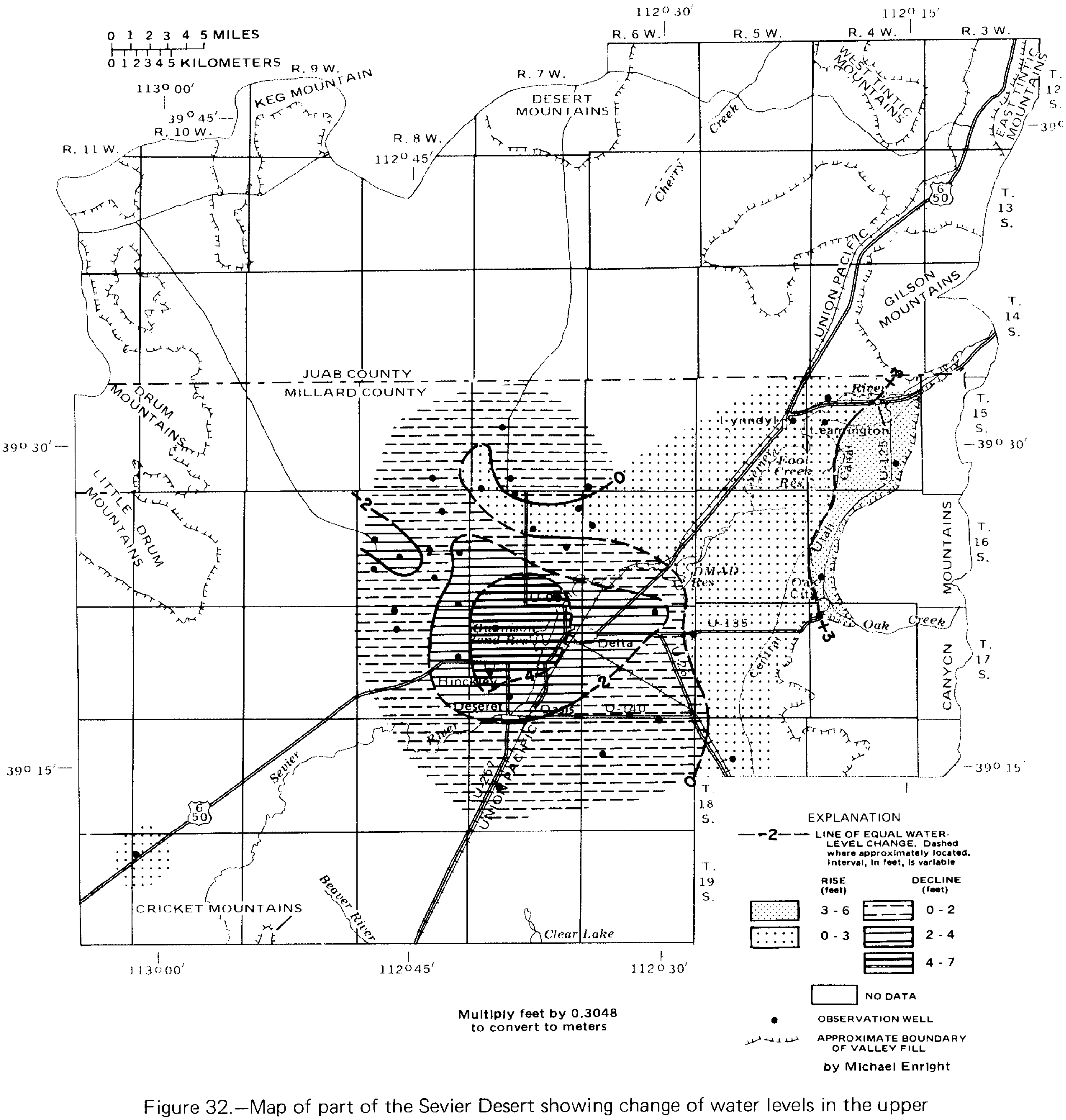


Figure 32.—Map of part of the Sevier Desert showing change of water levels in the upper artesian aquifer from March 1963 to March 1983.

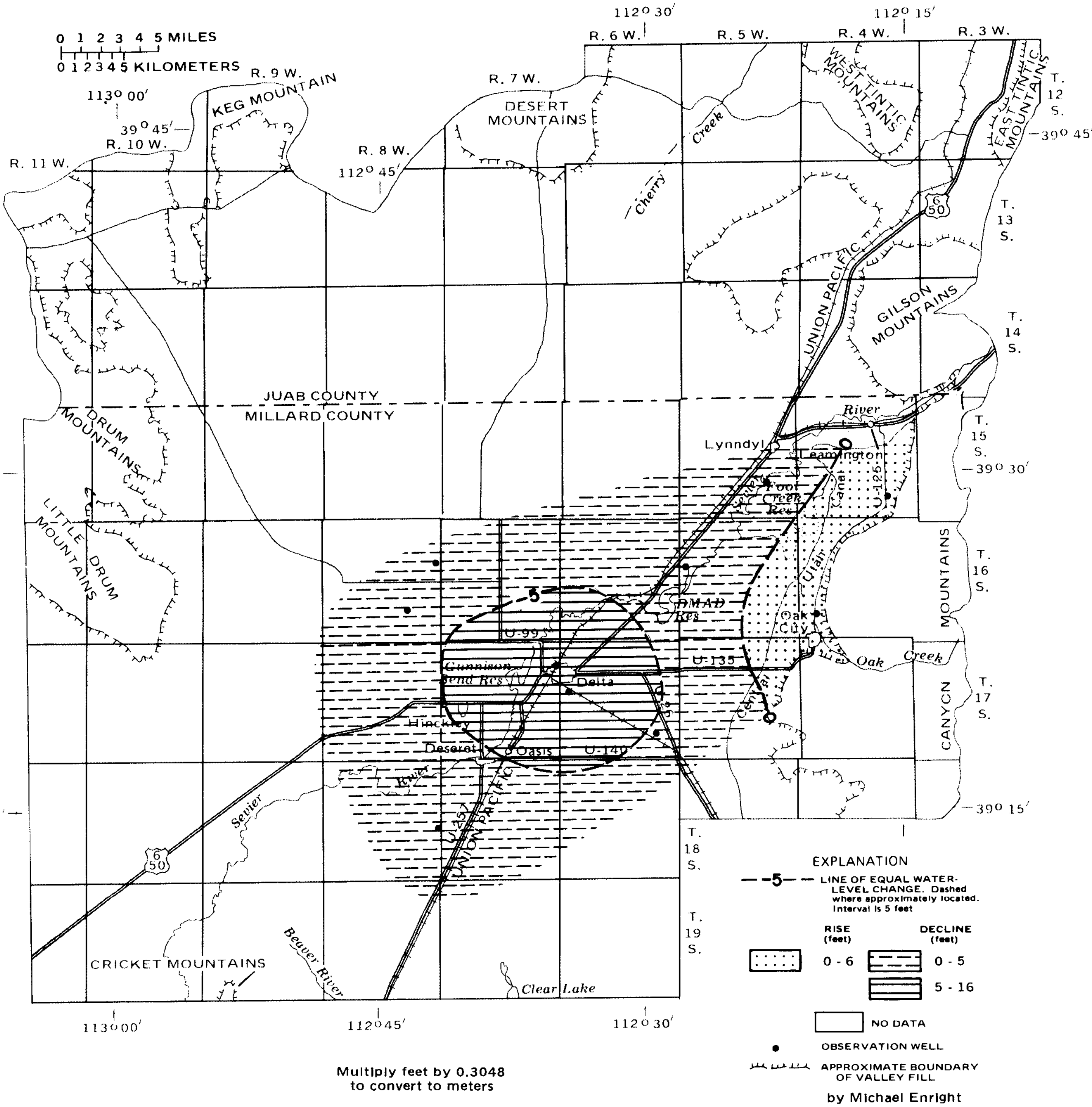


Figure 33.—Map of part of the Sevier Desert showing change of water levels in the lower artesian aquifer from March 1963 to March 1983.

UPPER AND CENTRAL SEVIER VALLEYS AND UPPER FREMONT RIVER VALLEY

by D. C. Emett

Withdrawal of water from wells in the upper and central Sevier Valleys and upper Fremont River valley was approximately 28,000 acre-feet (34 hm^3) in 1982, 3,000 acre-feet (3.7 hm^3) more than in 1981, and about 5,000 acre-feet (6.2 hm^3) more than the 1972-81 average annual withdrawal (table 2). Larger withdrawals for irrigation and public supply accounted for most of the increase. Withdrawals for domestic and stock use were about the same as in 1981.

Water levels rose from March 1982 to March 1983 in 22 of 28 selected observation wells (fig. 34). Rises ranged from 0.1 to 3.1 feet (0.03 to 0.94 m). The maximum rise was in a well near the East Fork of the Sevier River in Emery Valley. Rises probably were due to above average streamflow and local decreased withdrawal from wells. Water levels declined in five of the observation wells and remained the same in one well. Declines were less than 1 foot (0.3 m).

Water levels rose from March-April 1963 to March 1983 in 13 selected observation wells (fig. 35). The maximum rise of 30.6 feet (9.33 m) was in a well near the East Fork of the Sevier River in John's Valley. Water levels declined in seven wells for the same period. The maximum decline of 6.2 feet (1.89 m) was in a well near the Fremont River downstream from Bicknell, Utah.

The relation of water levels in three observation wells to discharge of the Sevier River at Hatch, to precipitation at Panguitch, Salina, and Loa, and to annual withdrawals from wells is shown in figure 36. Precipitation was above average at all three sites and water levels rose in all of the wells for which hydrographs are shown.

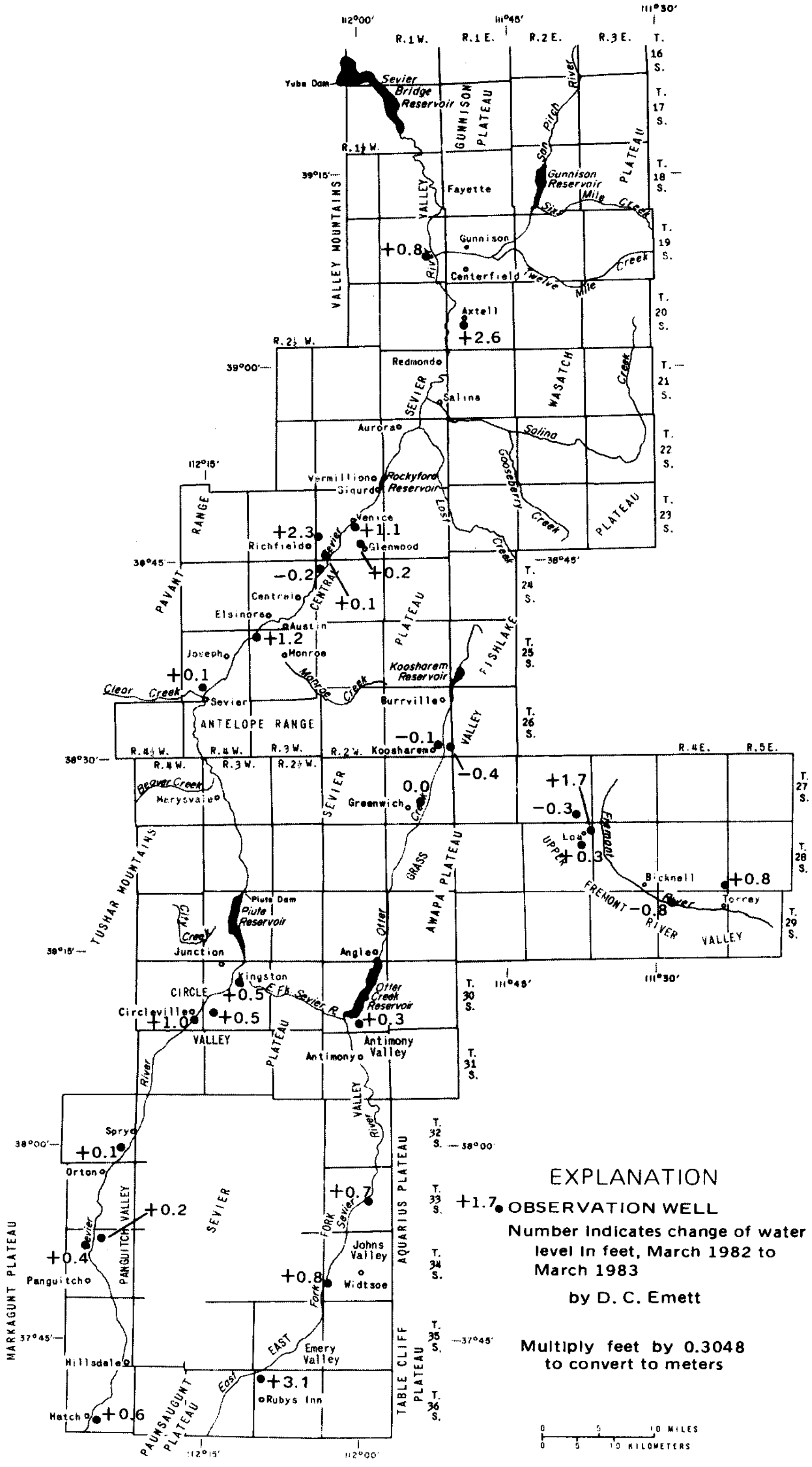


Figure 34.—Map of the upper and central Sevier River Valleys and upper Fremont River valley showing change of water levels from March 1982 to March 1983.

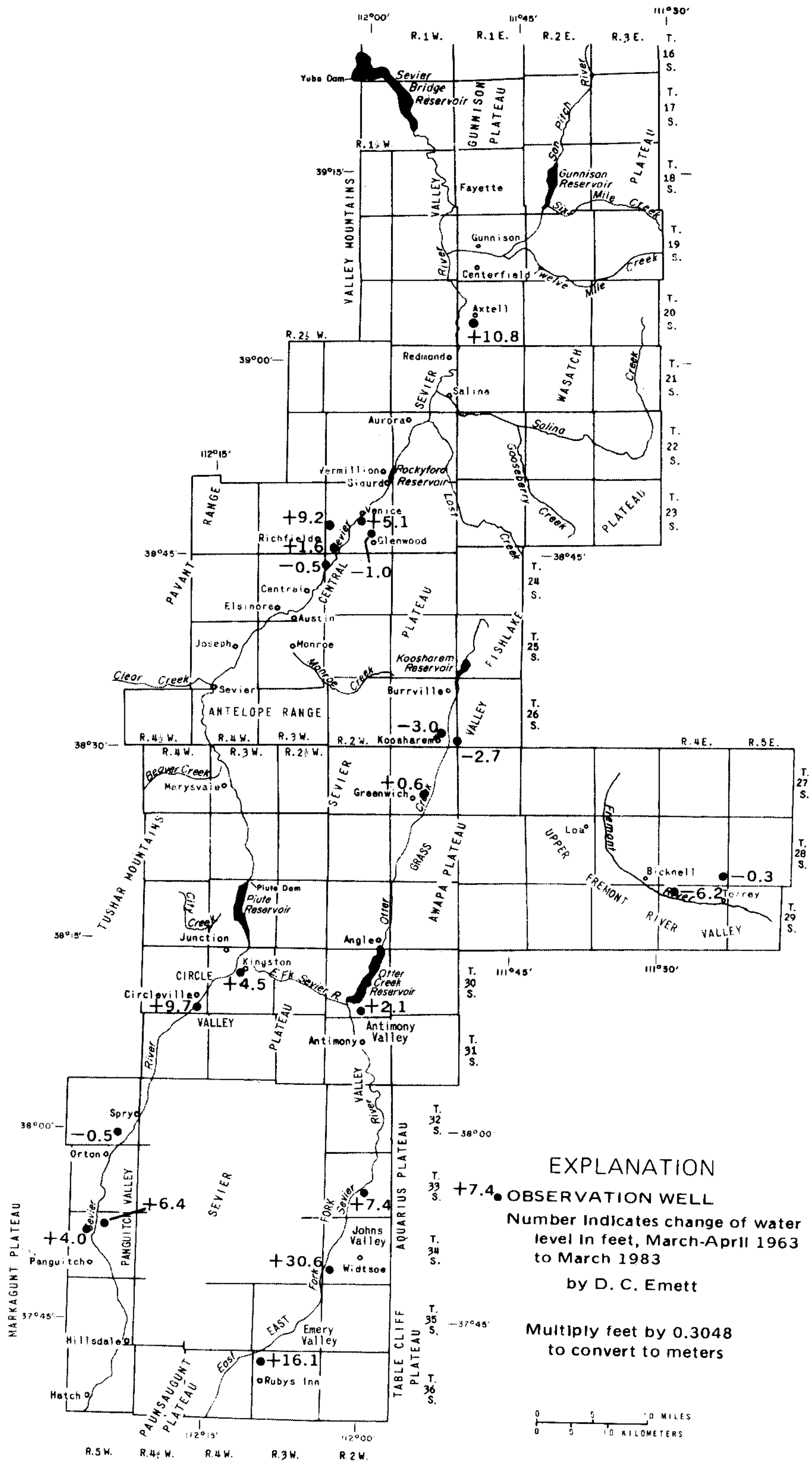


Figure 35.—Map of the upper and central Sevier Valleys and upper Fremont River valley showing change of water levels from March-April 1963 to March 1983.

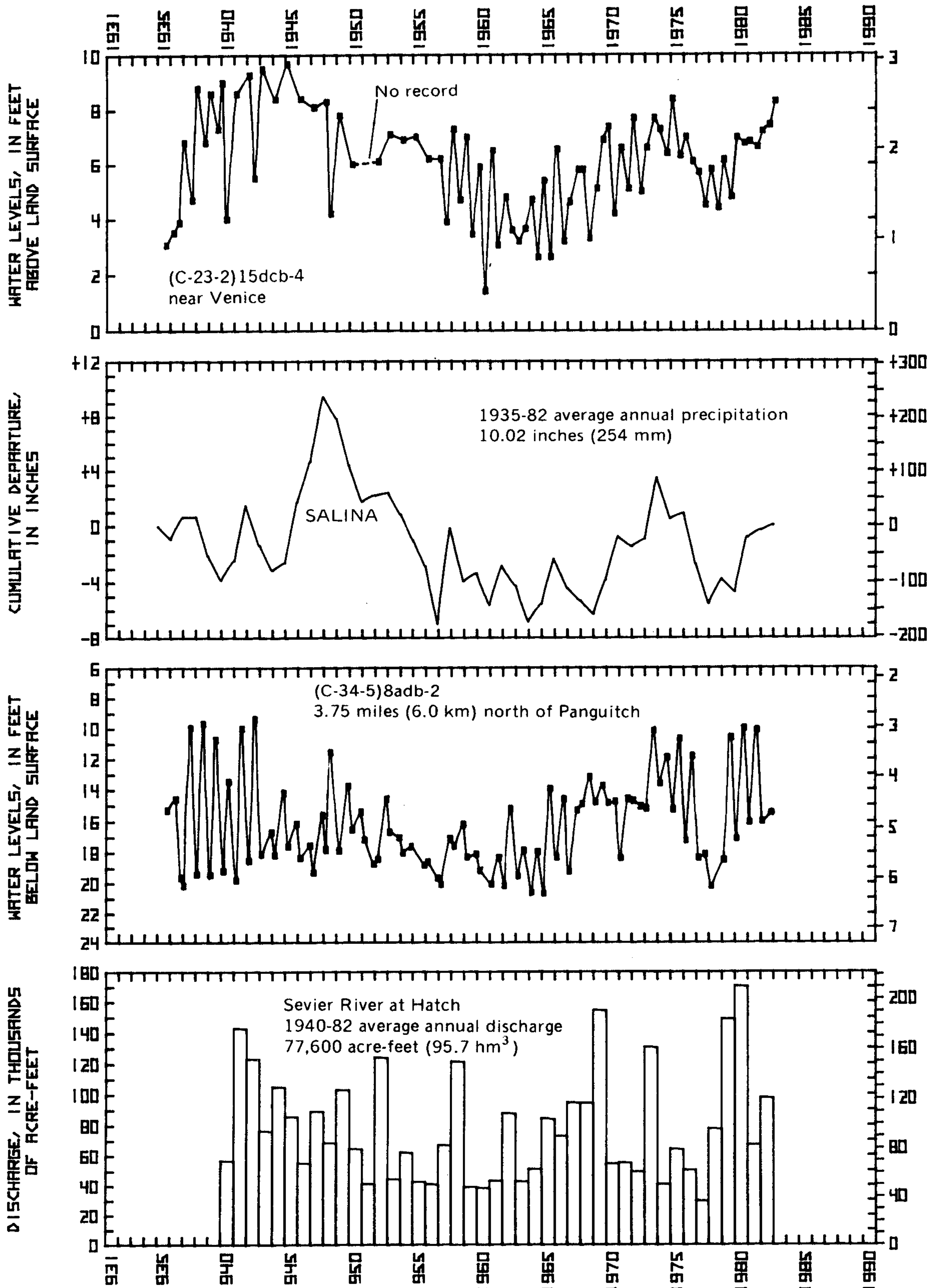


Figure 36.—Relation of water levels in selected wells to discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at selected climate stations, and to annual withdrawals from wells—upper and central Sevier Valleys and upper Fremont River valley.

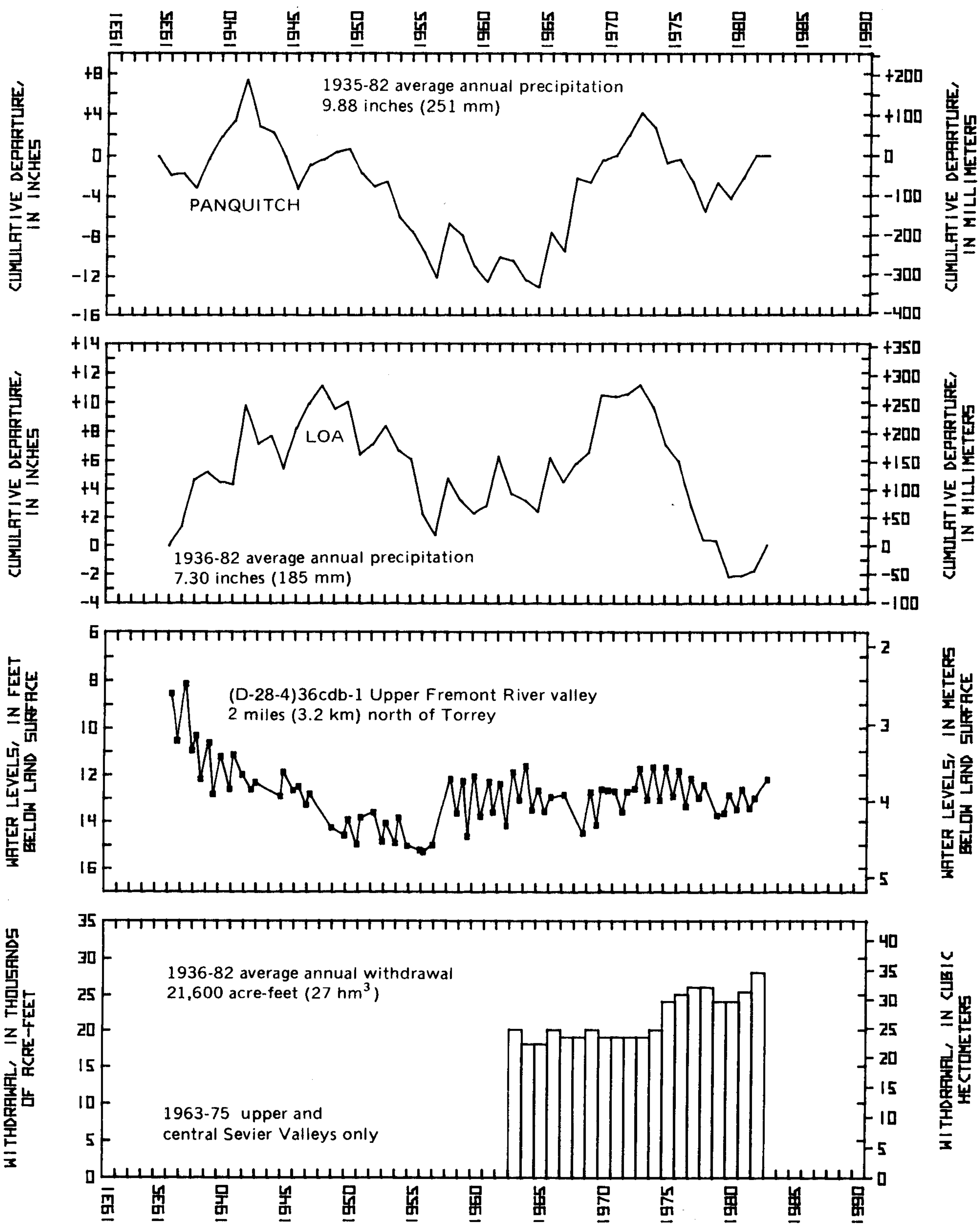


Figure 36.—Continued

PAVANT VALLEY

by Carole Burden

Withdrawal of water from wells in Pavant Valley in 1982 was 69,000 acre-feet (85 hm^3), which was 11,000 acre-feet (14 hm^3) less than reported for 1981 and 22,000 acre-feet (27 hm^3) less than the 1972-81 average annual withdrawal (table 2). The change from 1981 to 1982 mainly was due to decreased withdrawal for irrigation.

Water levels in most observation wells rose from March 1982 to March 1983 (fig. 37). Most of the rises were less than 3 feet (0.9 m); however, rises of as much as 6 feet (1.8 m) were observed in wells southeast of Flowell and north of Meadow. Rises were due to decreased withdrawal for irrigation and above average precipitation. Most of the declines, all less than 3 feet (0.9 m), were in the McCornick District. These declines were due to continual large withdrawals for irrigation.

Water-level changes from March 1963 to March 1983 are shown in figure 38. Water levels declined in the heavily-pumped areas in the northern and southern parts of the valley. Declines of almost 39 feet (12 m) occurred in the northern part of the valley. Water levels rose in the central part of the valley, with rises of as much as 28 feet (8.5 m) observed west of Holden.

The long-term relation of precipitation at Fillmore, water levels in selected observation wells, and annual withdrawals from wells are shown in figure 39. Precipitation at Fillmore in 1982 was 21.27 inches (540 mm), which is 6.65 inches (169 mm) above the 1931-82 average annual precipitation (fig. 39).

Concentrations of dissolved solids in water from selected wells in Pavant Valley are shown in figure 40. As shown, concentrations in the ground water increased slightly from 1981 to 1982 at well (C-23-6)21bdd-1, and decreased at well (C-21-5)7cdd-3. Concentrations at well (C-23-5)5acd-1 decreased from 1980 to 1982. A sample was not collected from well (C-23-6)8abd-1 in 1982.

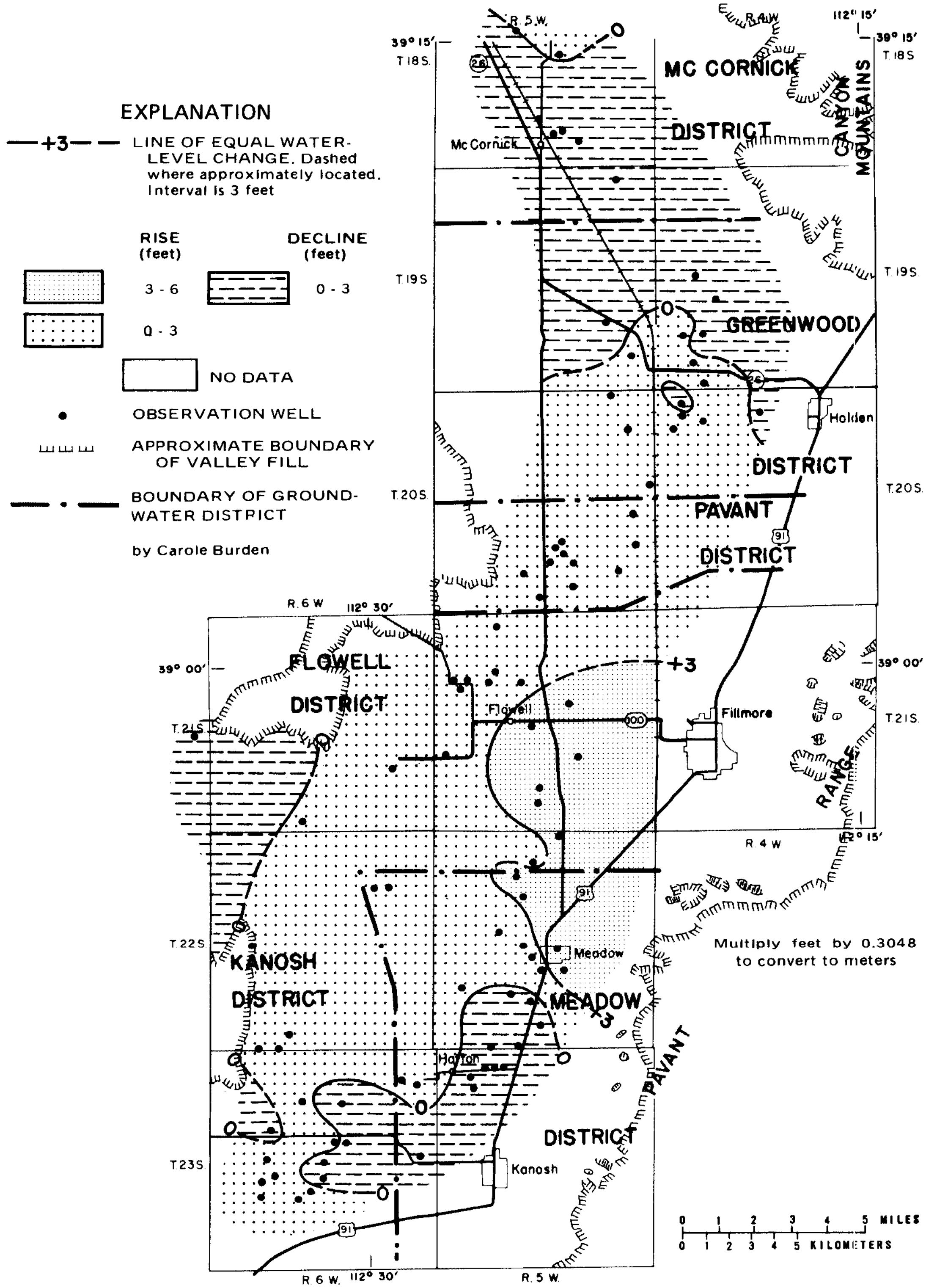


Figure 37.—Map of Pavant Valley showing change of water levels from March 1982 to March 1983.

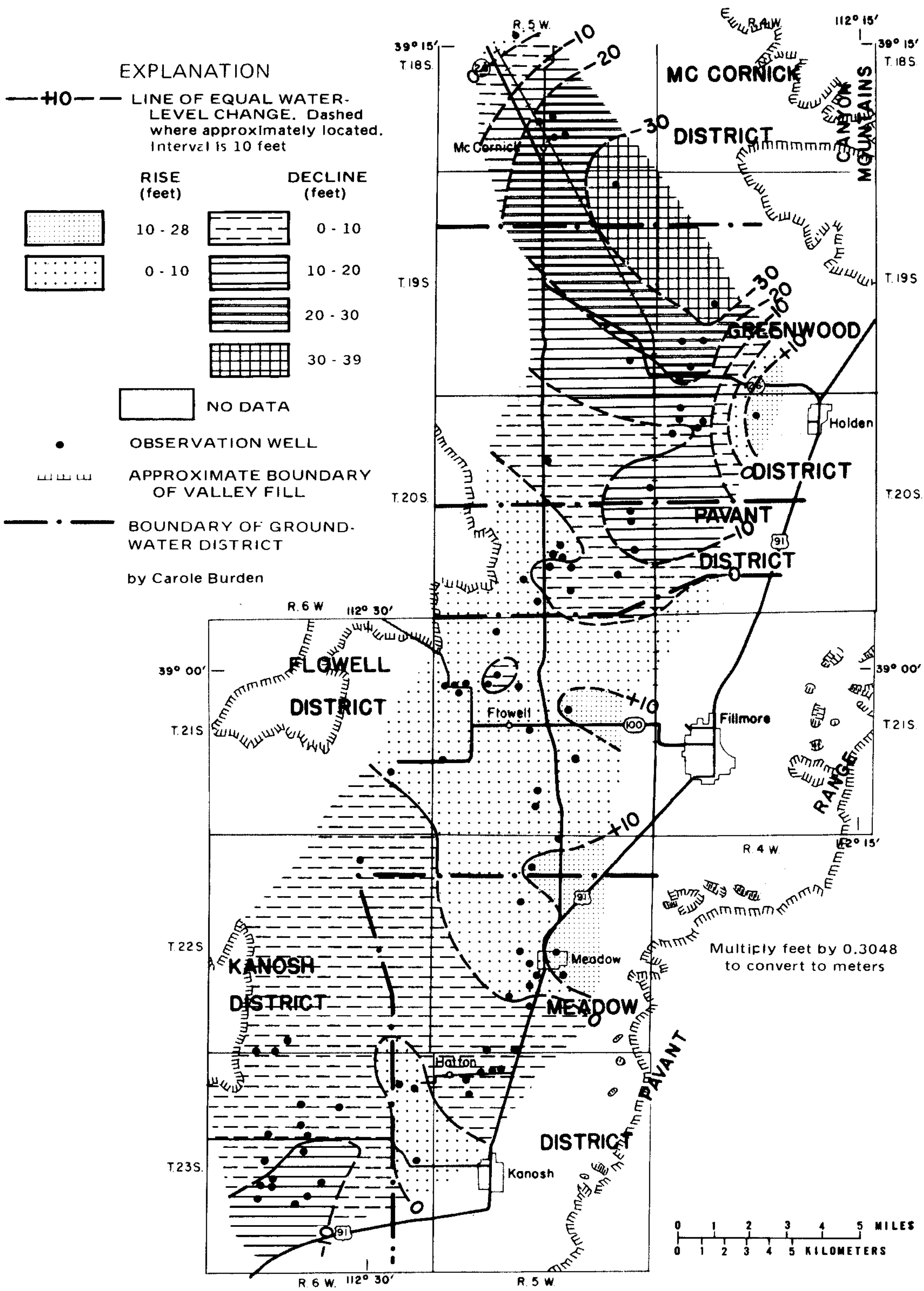


Figure 38.—Map of Pavant Valley showing change of water levels from March 1963 to March 1983.

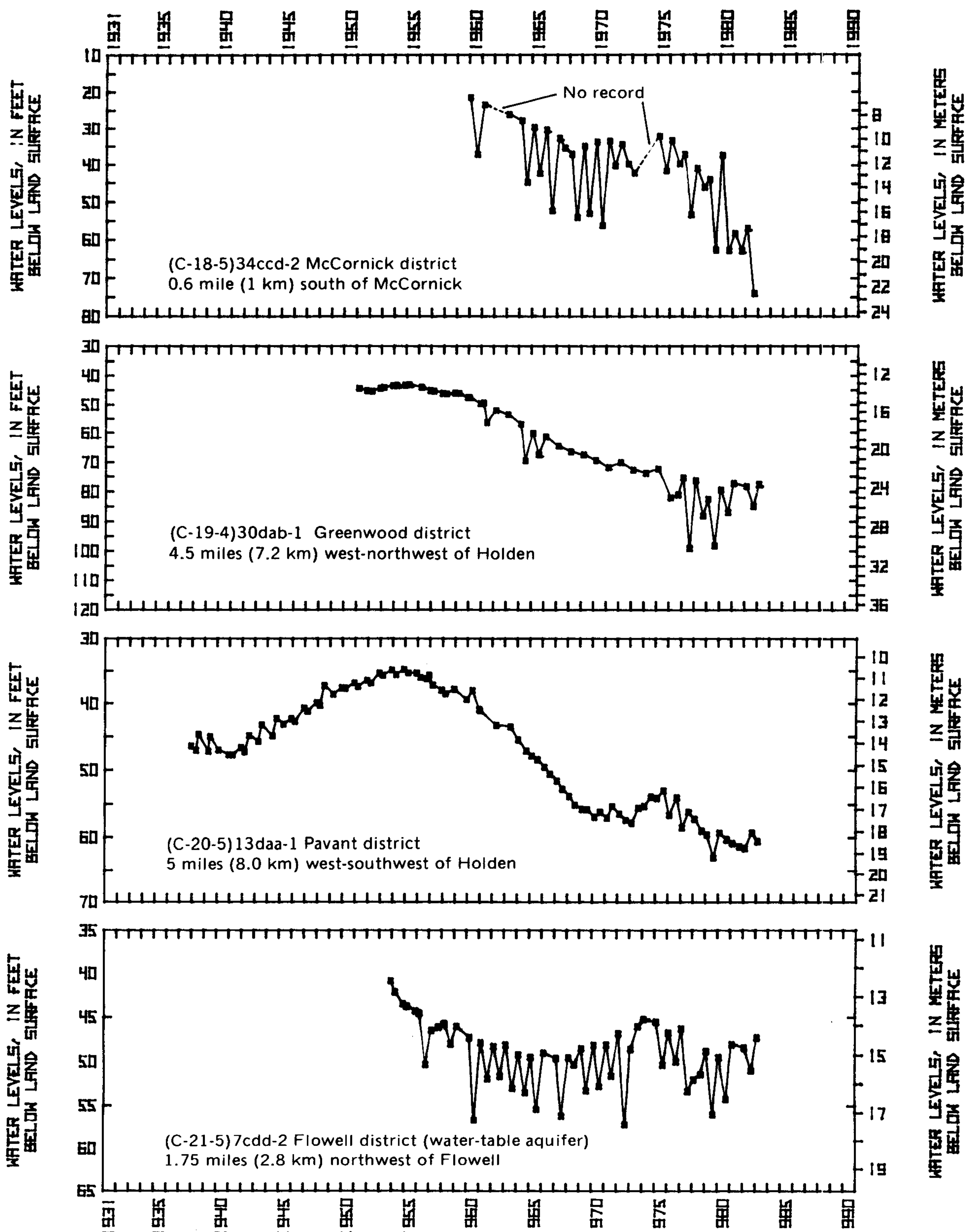


Figure 39.—Relation of water levels in selected wells in Pavant Valley to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells.

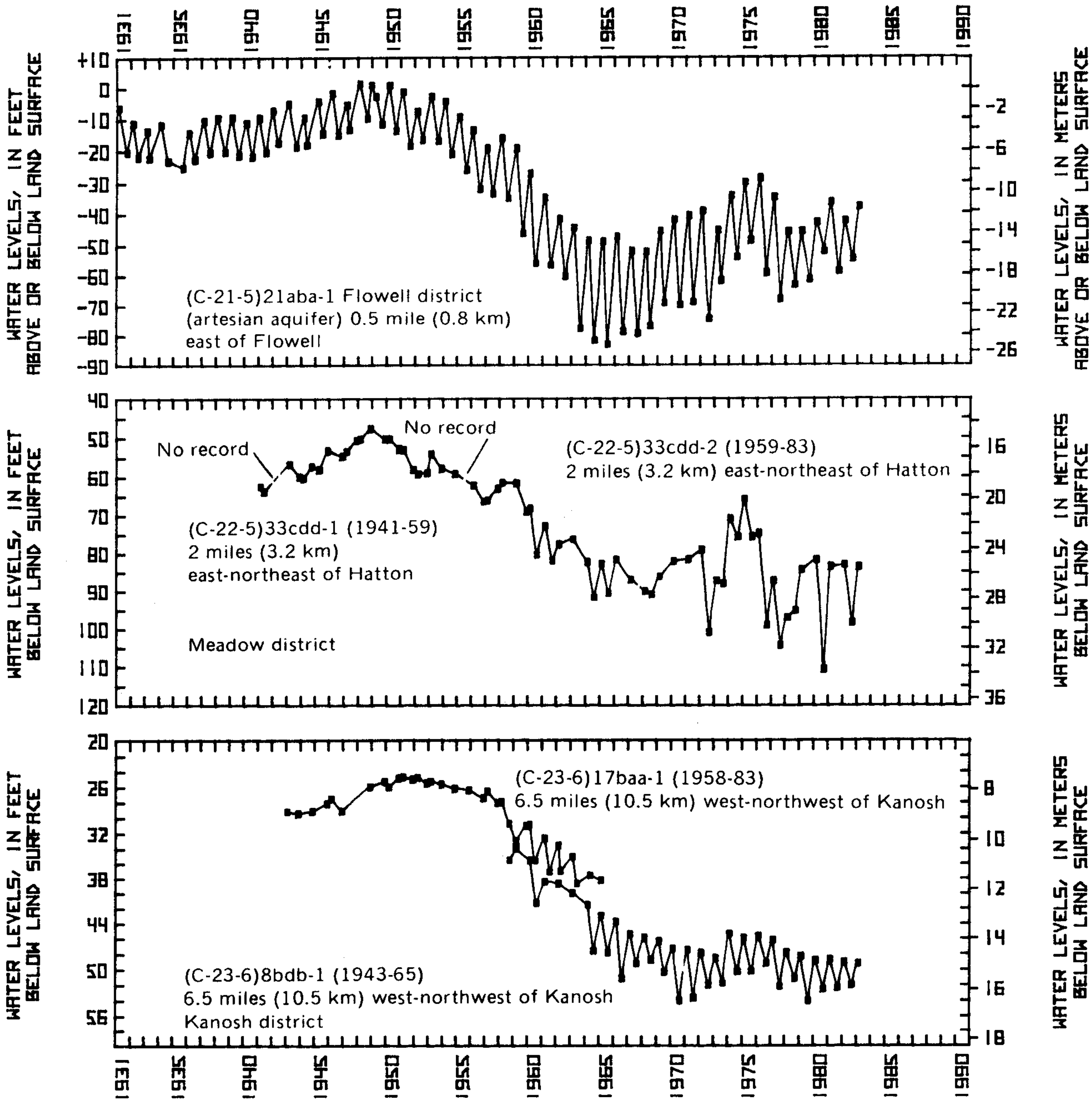


Figure 39.—Continued

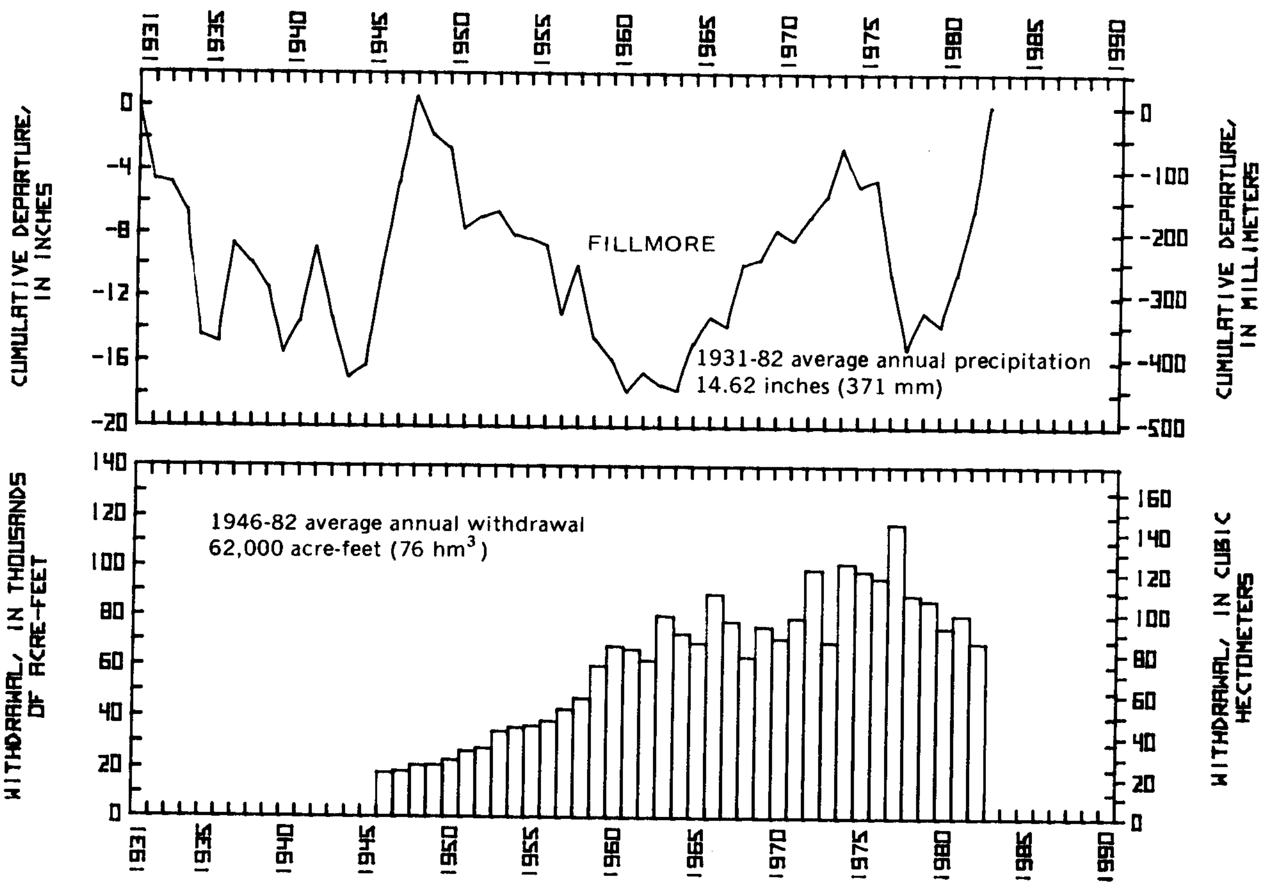


Figure 39.—Continued

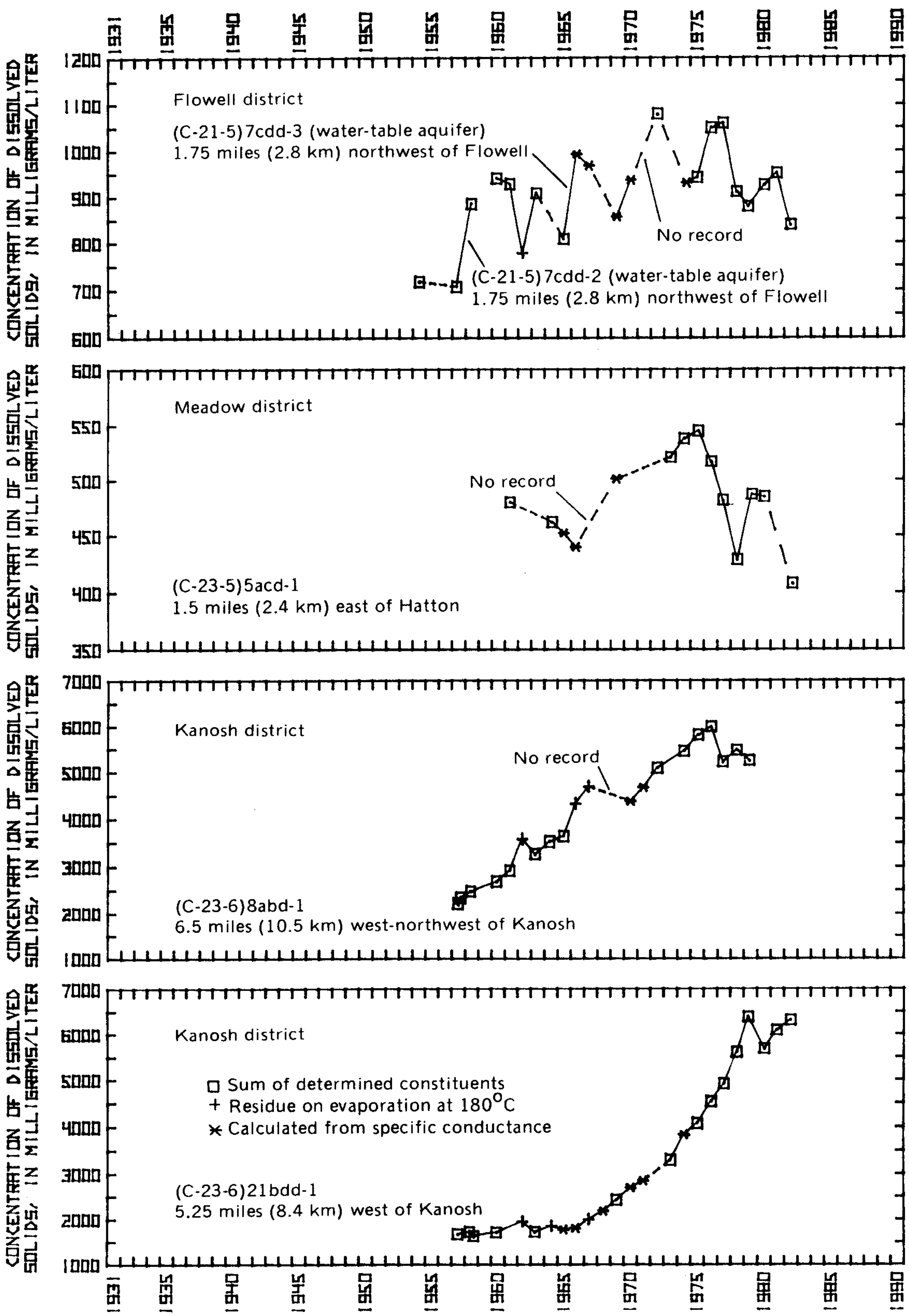


Figure 40.—Concentration of dissolved solids in water from selected wells in Pavant Valley.

CEDAR CITY VALLEY

by R. C. Beard

Withdrawal of water from wells in Cedar City Valley during 1982 was approximately 32,000 acre-feet (39 hm^3), an increase of 3 000 acre-feet (3.7 hm^3) from the amount reported in 1981, and about 1,000 acre-feet (1.2 hm^3) less than the 1972-81 average annual withdrawal (table 2). The increase largely was due to more accurate determination of withdrawals for domestic and stock use.

Water levels generally rose in most of the valley but slightly declined in the northeast part of the valley from March 1982 to March 1983 (fig. 41). The largest rise, nearly 7 feet (2 m), was in the southwest part of the valley. Declines of less than 2 feet (0.6 m) were recorded in the Enoch-Rush Lake area.

Water levels from 1963 to 1983 rose by as much as 25 feet (7.6 m) in the east-central part of the valley and by nearly 20 feet (6.1 m) near Kanarraville (fig. 42). The rise in these areas probably was due to above average streamflow in Coal and Kanarra Creeks. Water levels declined in the rest of the valley. Declines were from 10 to 15 feet (3.0 to 4.6 m) north of Enoch and near Quichapa Lake.

Figure 43 shows water levels in well (C-35-11)33aac-1, cumulative departure from average annual precipitation at Cedar City, discharge of Coal Creek, and annual withdrawals from wells in Cedar City Valley. The rise in the water level in well (C-35-11) 33aac-1 probably reflects the increased discharge of Coal Creek during the year as a result of above average precipitation.

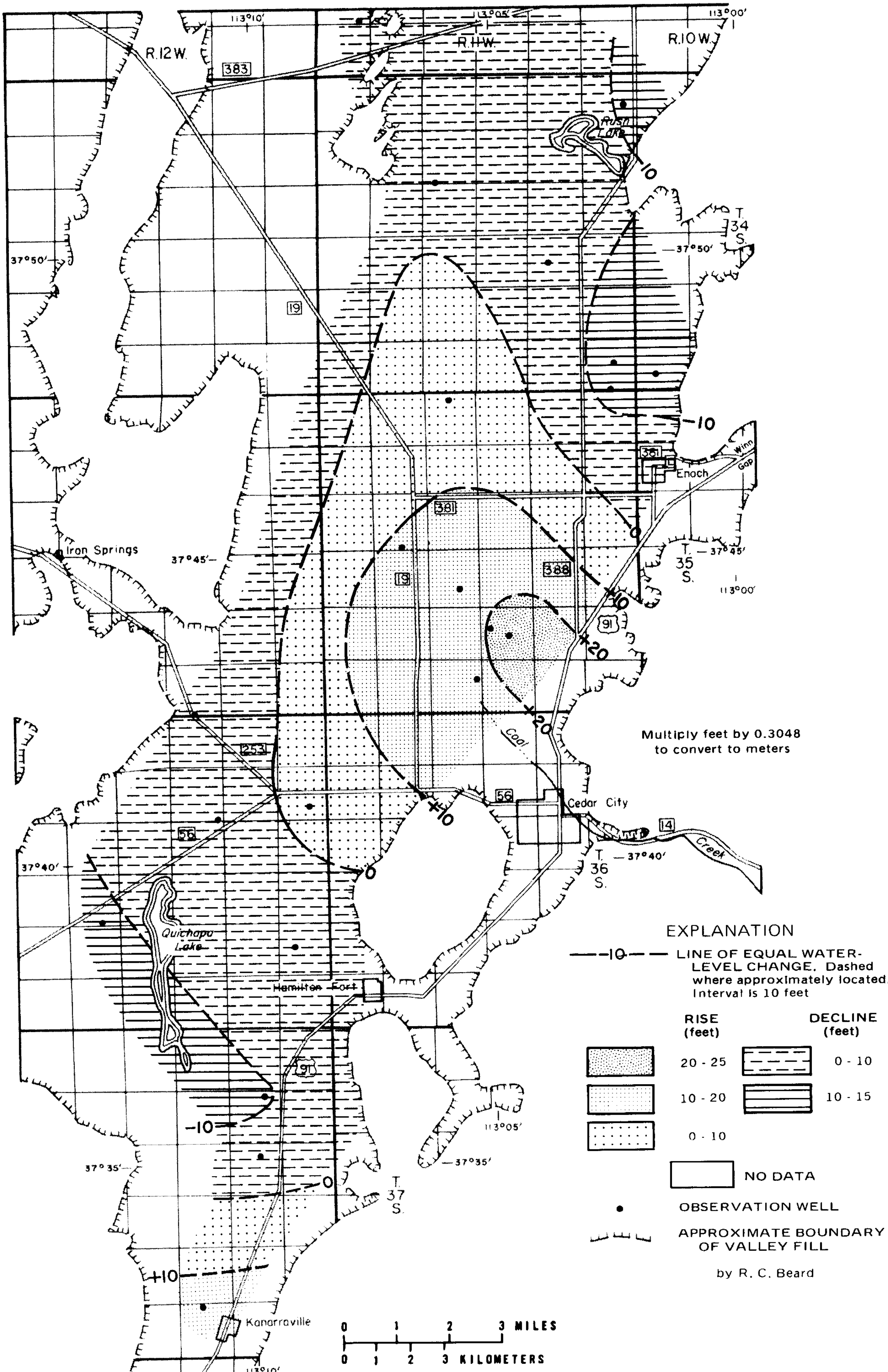


Figure 42.—Map of Cedar City Valley showing change of water levels from March 1963 to March 1983.

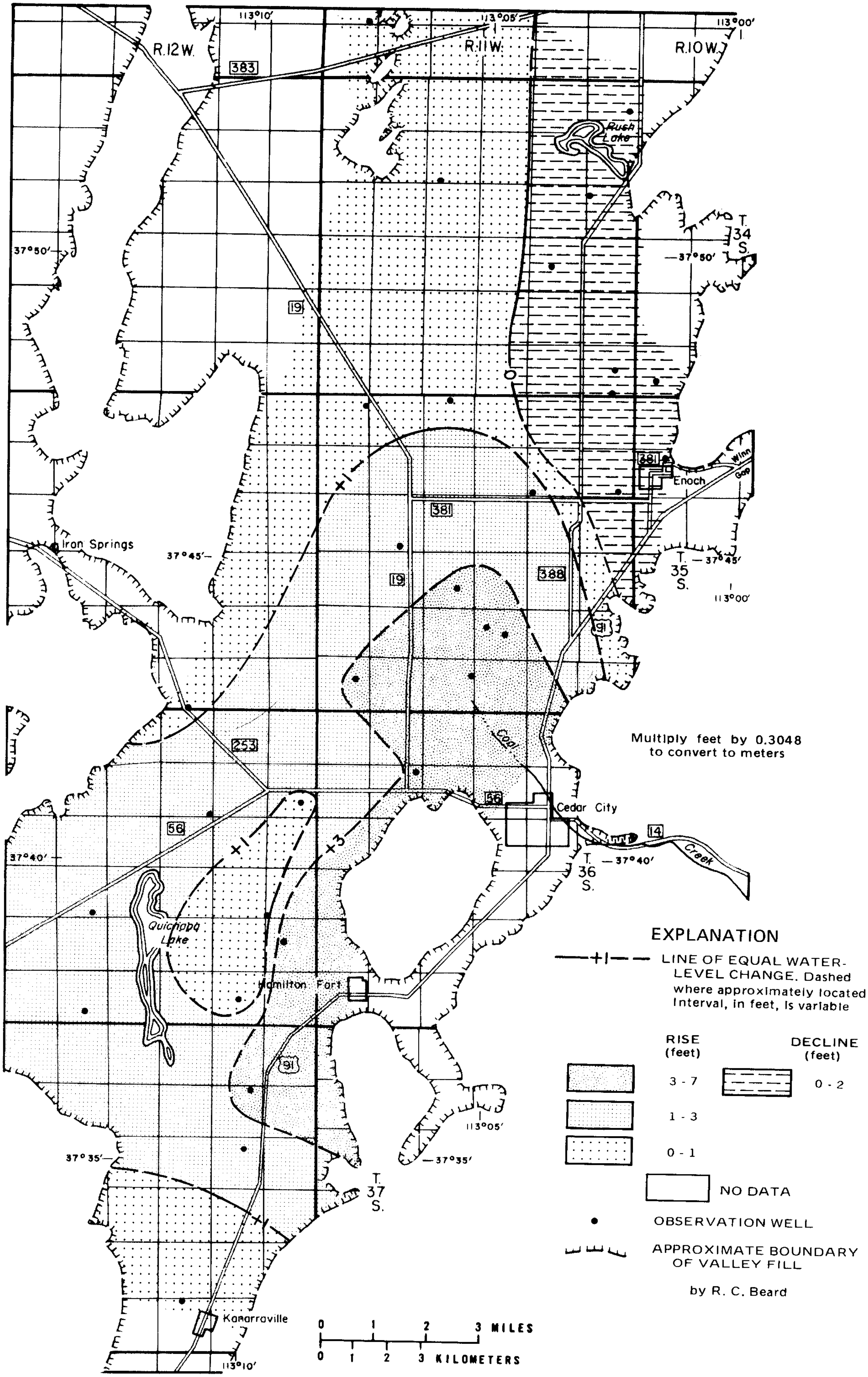


Figure 41.—Map of Cedar City Valley showing change of water levels from March 1982 to March 1983.

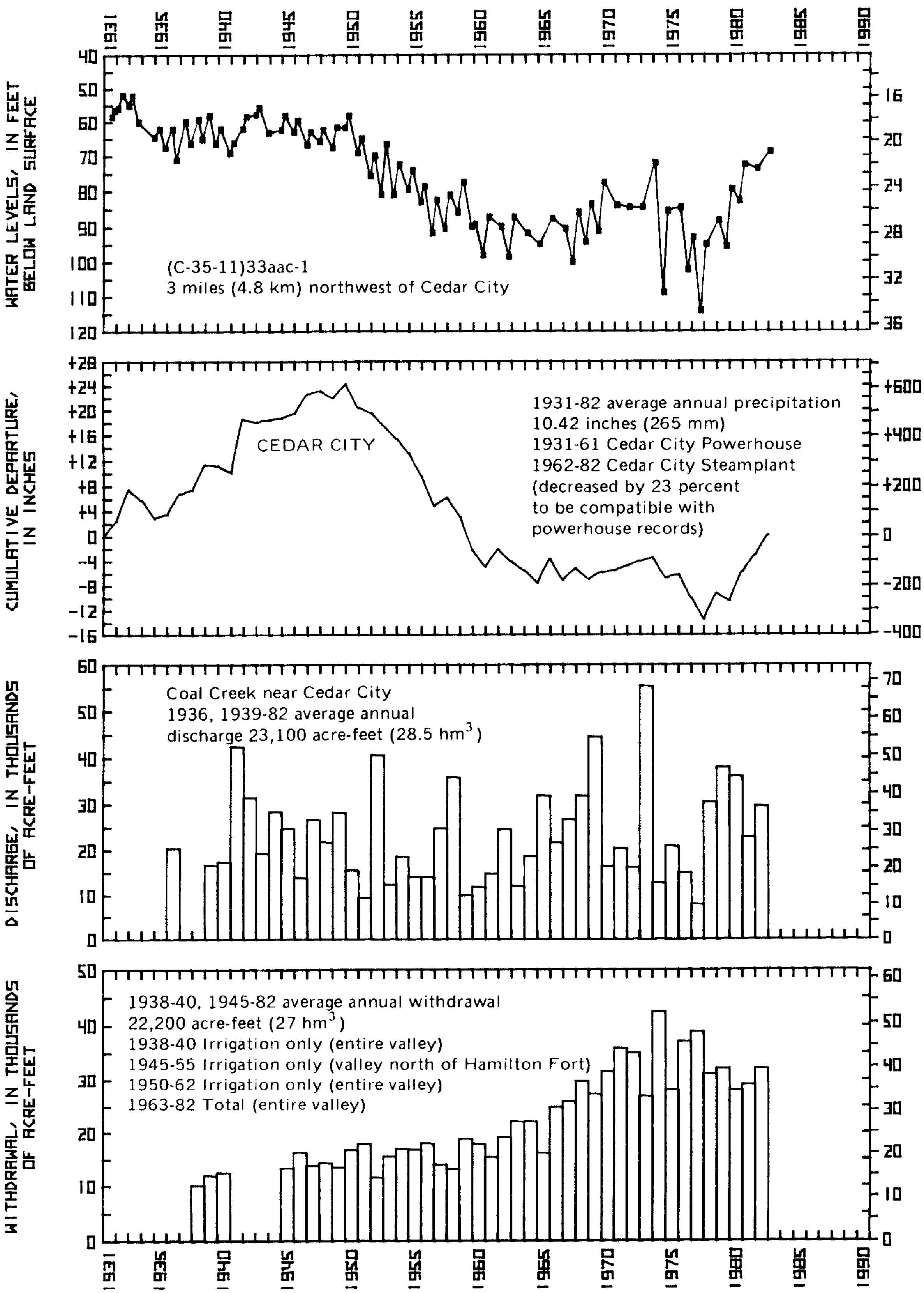


Figure 43.—Relation of water levels in well (C-35-11)33aac-1 in Cedar City Valley to cumulative departure from the average annual precipitation at the Cedar City Powerhouse, to discharge of Coal Creek near Cedar City, and to annual withdrawals from wells.

PAROWAN VALLEY

by L. G. Sultz

Withdrawal of water from wells in Parowan Valley was about 25,000 acre-feet (31 hm^3) in 1982. This was 2,000 acre-feet (2.5 hm^3) less than reported for 1981 and 4,000 acre-feet (4.9 hm^3) less than the 1972-81 average annual withdrawal (table 2). Withdrawals for irrigation and public supply declined while withdrawals for other uses remained about the same.

Water levels from March 1982 to March 1983 rose in the central and northern parts of the valley (fig. 44). The rises were less than 2 feet (0.6 m) and were due to above average precipitation and the decline in withdrawal for irrigation. Water-level declines occurred north of Paragonah and Summit. The declines were less than 3 feet (0.9 m) and were due to continued large withdrawals.

The change in water levels in Parowan Valley from February-March 1963 to March 1983 are shown in figure 45. Water levels declined throughout the irrigated portion of the valley. The water level rose in one observation well outside the irrigated areas.

The relation of water levels in well (C-34-8)5bca-1 to annual withdrawals from wells and cumulative departure from the average annual precipitation at Parowan Airport is shown in figure 46. The water level in well (C-34-8)5bca-1 rose due to above normal precipitation and an increase in recharge from streamflow.

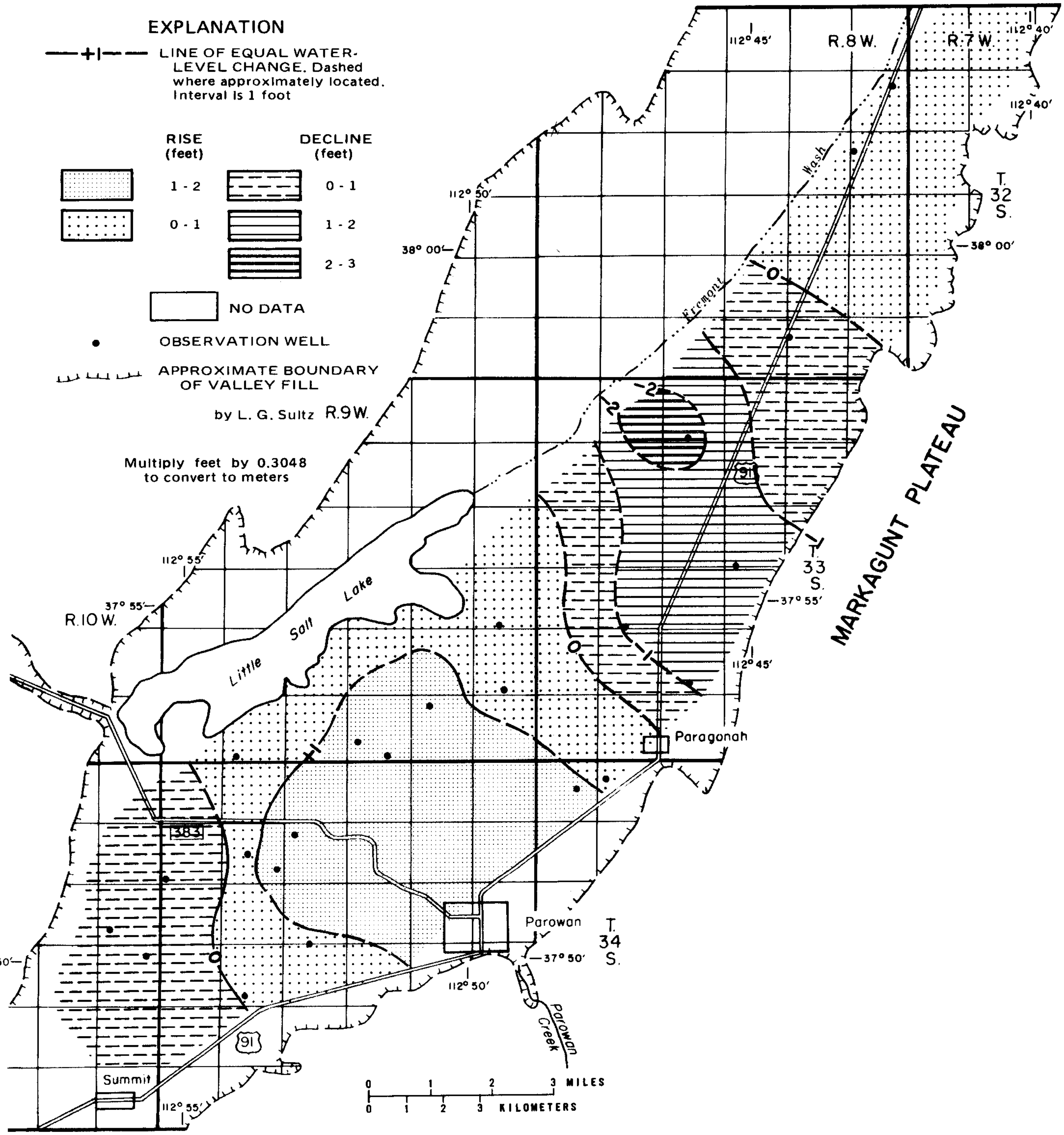


Figure 44.—Map of Parowan Valley showing change of water levels from March 1982 to March 1983.

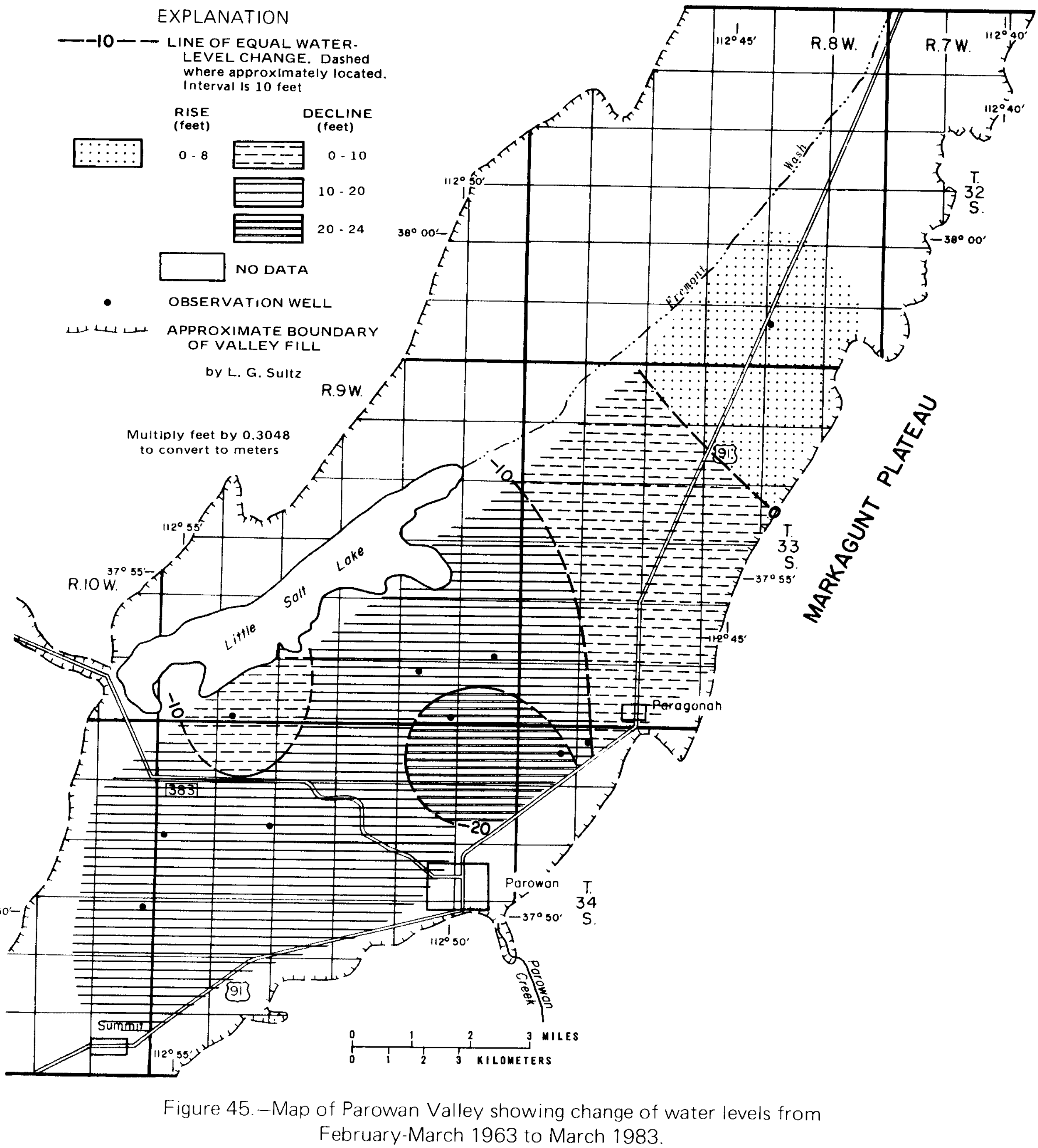


Figure 45.—Map of Parowan Valley showing change of water levels from February-March 1963 to March 1983.

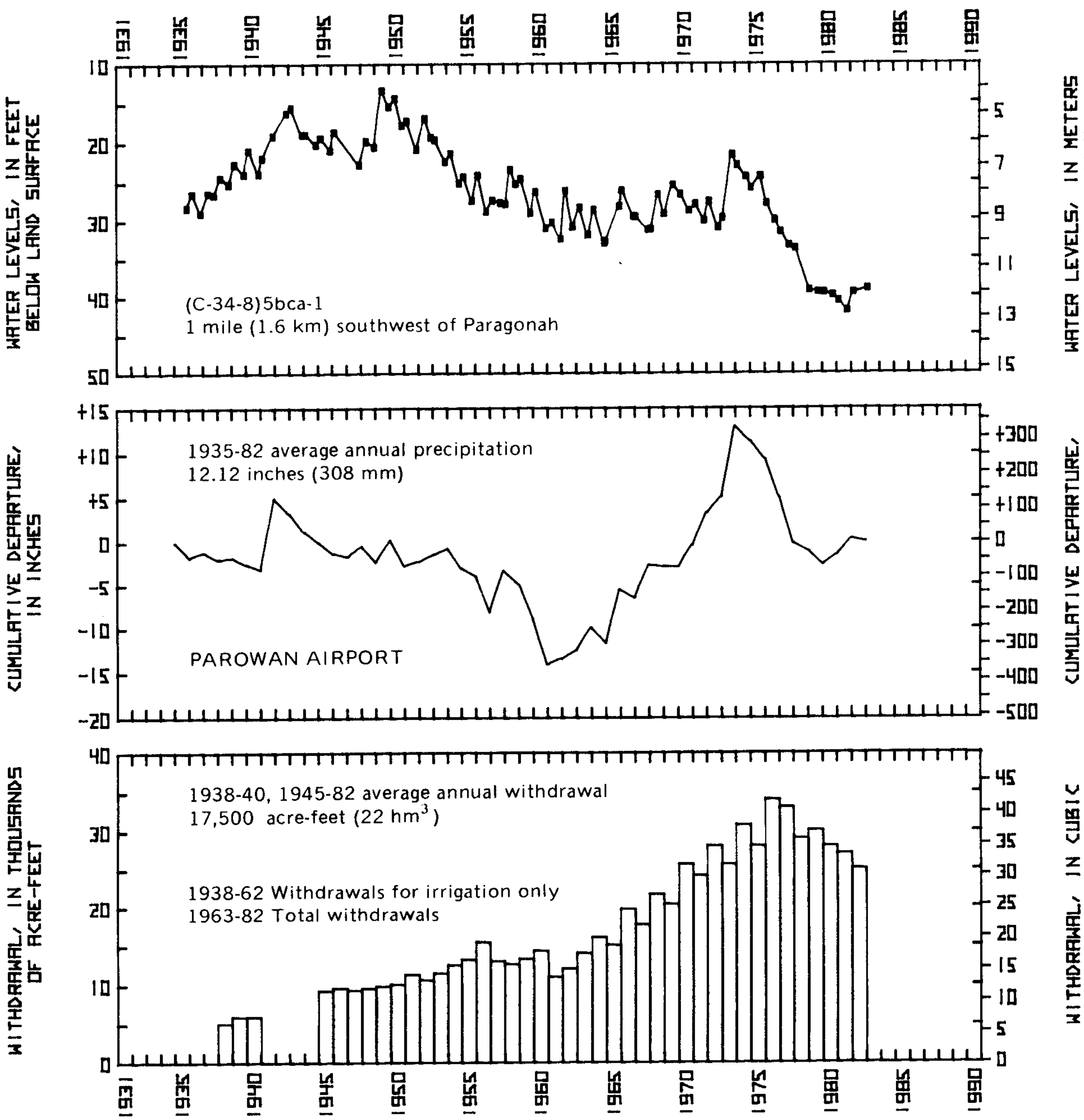


Figure 46.—Relation of water levels in well (C-34-8)5bca-1 in Parowan Valley to cumulative departure from the average annual precipitation at Parowan Airport and to annual withdrawals from wells.

Milford area

by M. R. Eckenwiler

Withdrawal of water from wells in the Milford area in 1982 was about 55,000 acre-feet (68 hm^3), 14,000 acre-feet (17 hm^3) less than the 1981 withdrawal, and 6,000 acre-feet (7.4 hm^3) less than the 1972-81 average annual withdrawal (table 2). The decrease probably was due to above average precipitation and therefore less withdrawal for irrigation.

Water levels declined in most of the area from March 1982 to March 1983 with the largest decline of as much as 4 feet (1.2 m) occurring in the heavily-pumped area south of Milford (fig. 47). Water levels rose, less than 1 foot (0.3 m), in the southeast, southwest, and northwest parts of the area due to above normal precipitation.

Water levels declined in most of the area from March 1963 to March 1983 (fig. 48) due to an increase in withdrawals over the years. Declines were as much as 19 feet (5.8 m). Along the canals in the eastern part of the area, water levels rose as much as 14 feet (4.3 m). These rises may have been due to increased recharge from the Beaver River. Water levels in wells in this area in 1963 were unusually low.

The relation of water levels in well (C-29-10)6ddc-2 to precipitation at Milford Airport, discharge of the Beaver River at Rocky Ford Dam, and annual withdrawals of water from wells is shown in figure 49. Discharge from the Beaver River was 34,820 acre-feet (42.9 hm^3) in 1982, 3,480 acre-feet (4.3 hm^3) more than in 1981, and about 8,700 acre-feet (10.7 hm^3) more than the 1932-82 average annual discharge.

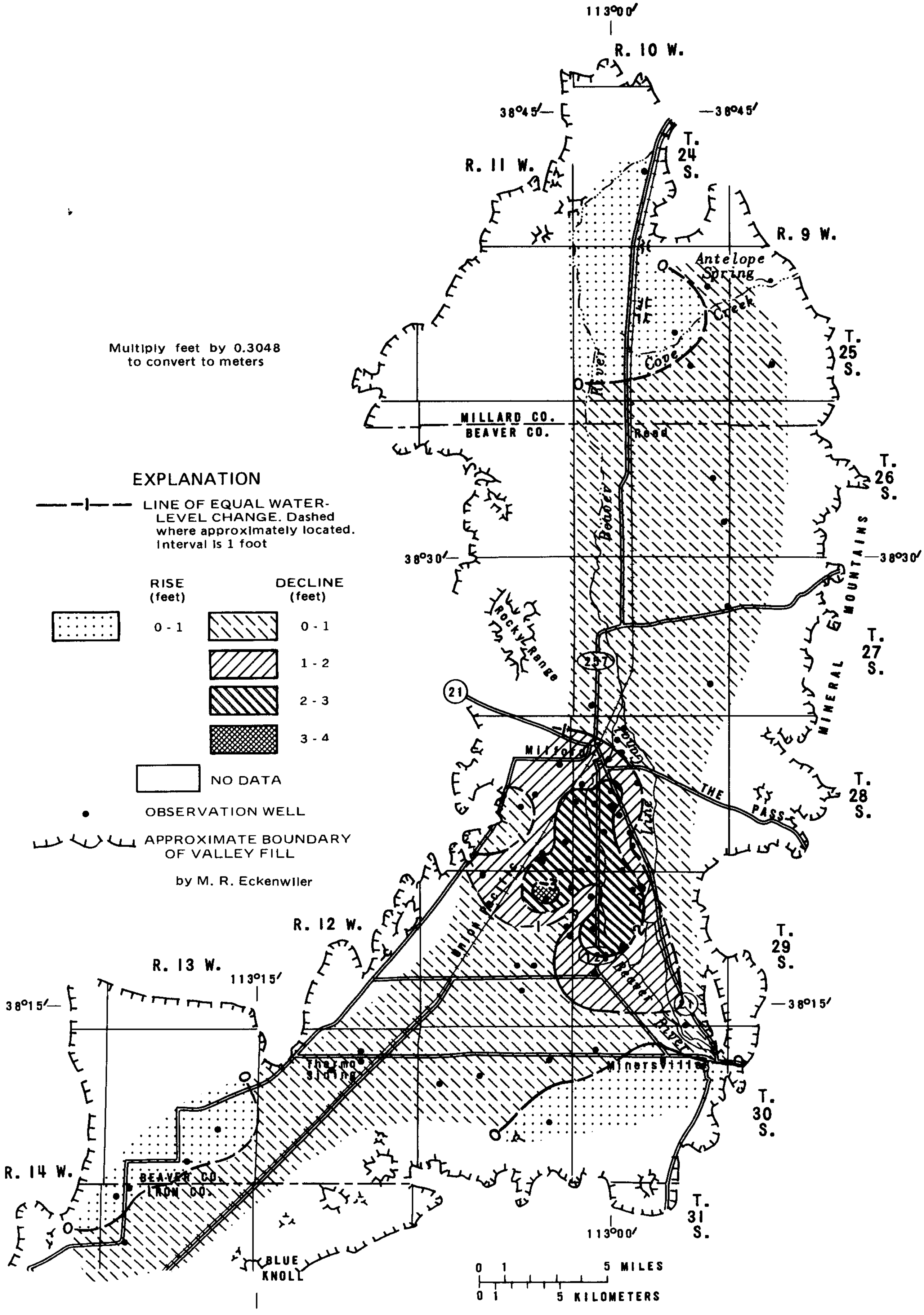


Figure 47.—Map of the Milford area, Escalante Valley, showing change of water levels from March 1982 to March 1983.

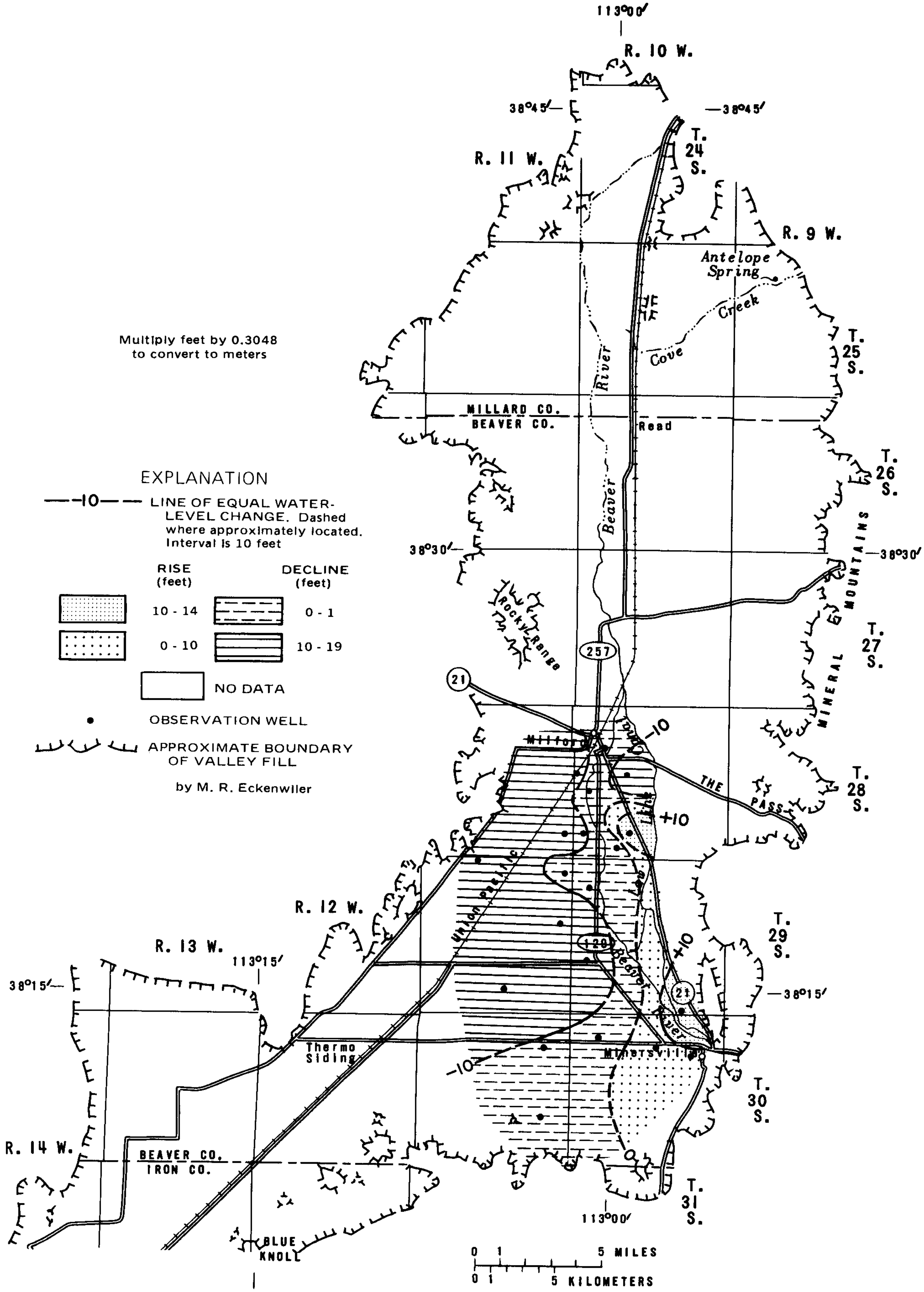


Figure 48.—Map of the Milford area, Escalante Valley, showing change of water levels from March 1963 to March 1983.

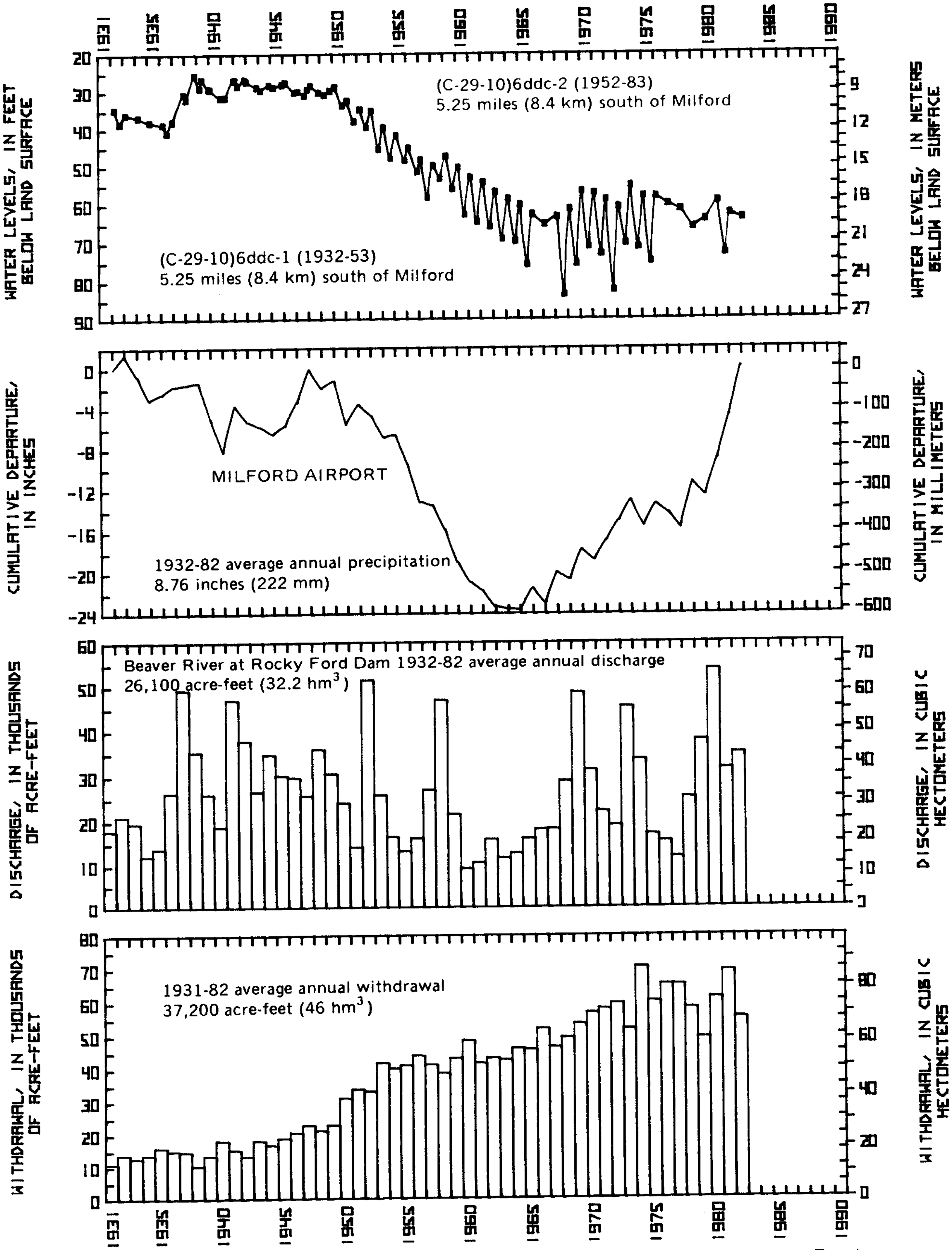


Figure 49.—Relation of water levels in well (C-29-10)6ddc-2 in the Milford area, Escalante Valley, to cumulative departure from the average annual precipitation at Milford Airport, to discharge of the Beaver River at Rocky Ford Dam, and to annual withdrawals from wells.

ESCALANTE VALLEY

Beryl-Enterprise area

by G. W. Sandberg

Withdrawal of water from wells in the Beryl-Enterprise area in 1982 was about 99,000 acre-feet (122 hm^3), an increase of 6,000 acre-feet (7.4 hm^3) from 1981, and 19,000 acre-feet (23 hm^3) more than the 1972-81 average annual withdrawal. The increase chiefly was due to increased irrigation and industrial withdrawals.

Water levels declined from March 1982 to March 1983 in most of the valley as a result of the increased withdrawal. The largest declines were about 3 miles (4.8 km) north of Enterprise (fig. 50). Water levels rose slightly in the northern part of the area and large rises occurred in the vicinity of Enterprise and west of Beryl Junction. Rises near Enterprise probably resulted from increased recharge from runoff entering the valley during February 1983. Rises west of Beryl Junction probably resulted from spreading of water diverted from a mine to the southwest.

Water-level changes from March 1963 to March 1983 are shown in figure 51. A slight rise occurred in the north near Lund and larger rises occurred in the south near Enterprise, because of recent local recharge. Water levels in most of the valley declined with the largest declines of about 34 feet (10 m) occurring in the heavily-pumped area near Newcastle and Beryl Junction. A rise of up to 25.8 feet (7.86 m) occurred around Enterprise. The relation of water levels in well (C-35-17)25dcd-1 to precipitation at Modena, and annual withdrawals of water from wells is shown in figure 52.

Changes in the concentration of dissolved solids in water from three wells in the Beryl-Enterprise area are shown in figure 53. The concentration of dissolved solids in 1982 was about the same as 1981 in water from well (C-37-17)12bdc-1 and increased slightly in water from well (C-34-16)28dcc-2. A sample was not collected from well (C-36-16)5L1-1 in 1982.

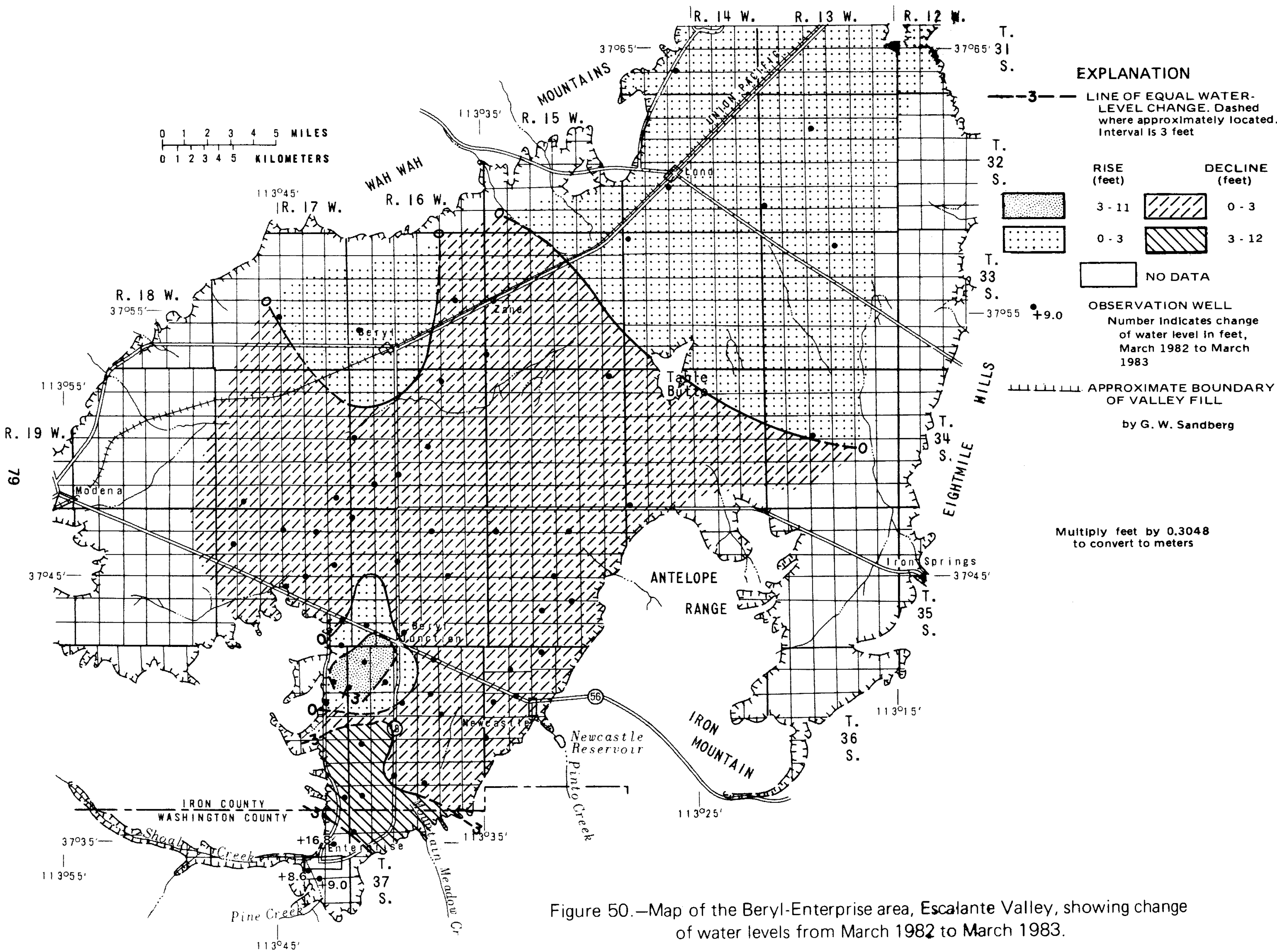


Figure 50.—Map of the Beryl-Enterprise area, Escalante Valley, showing change of water levels from March 1982 to March 1983.

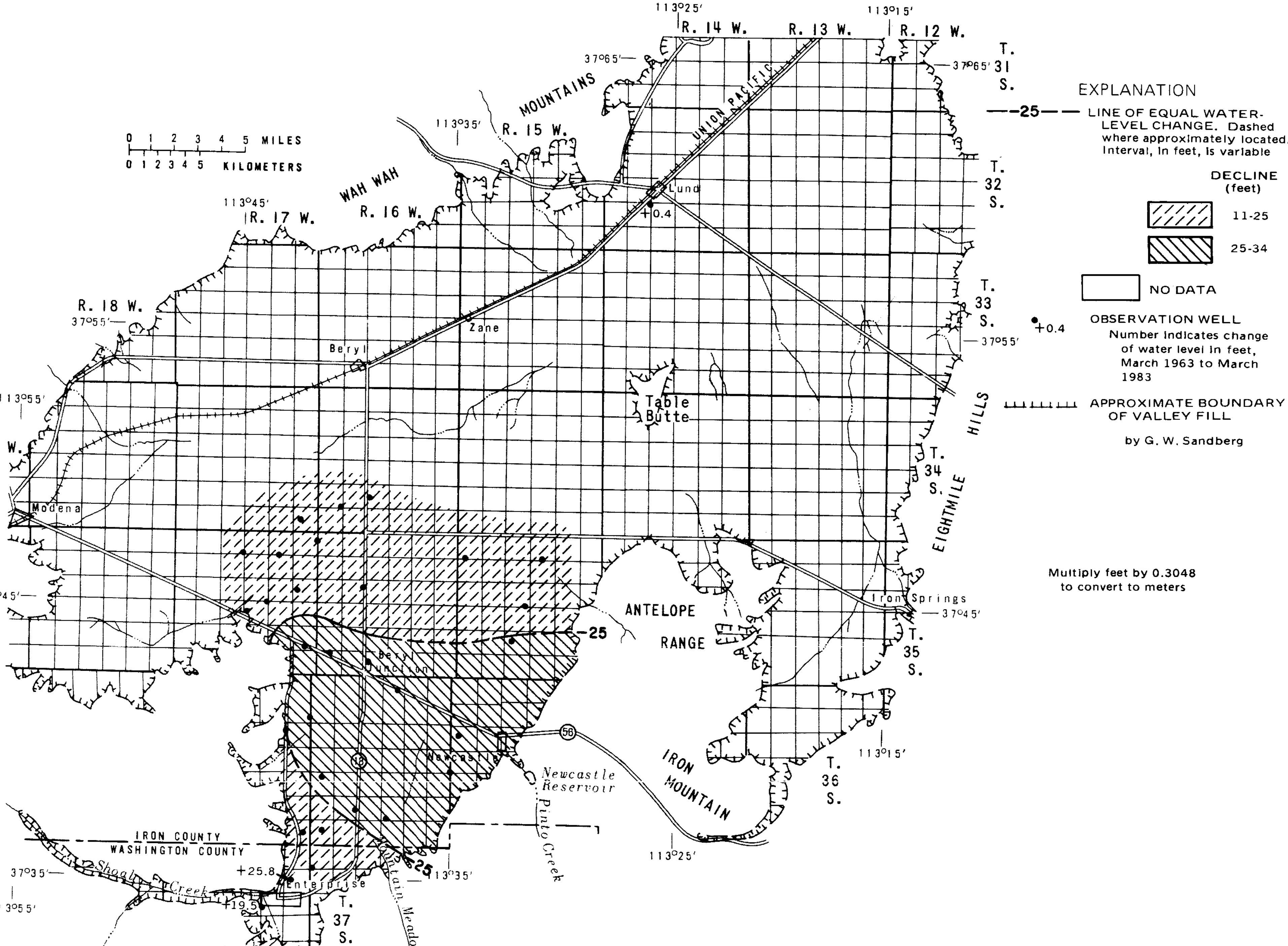


Figure 51.—Map of the Beryl-Enterprise area, Escalante Valley, showing change

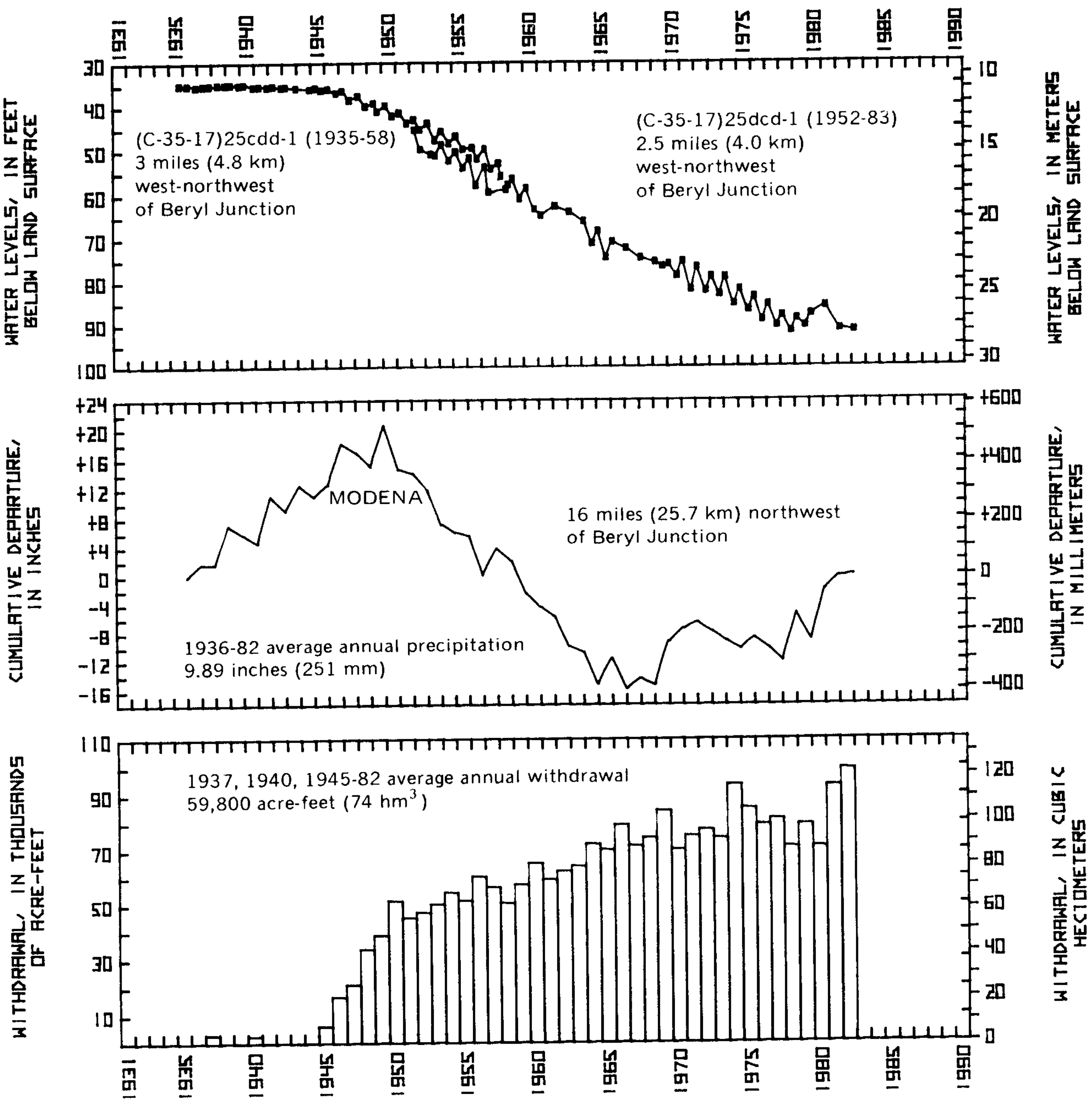


Figure 52.—Relation of water levels in well (C-35-17)25dcd-1 in the Beryl-Enterprise area, Escalante Valley, to cumulative departure from the average annual precipitation at Modena and to annual withdrawals from wells.

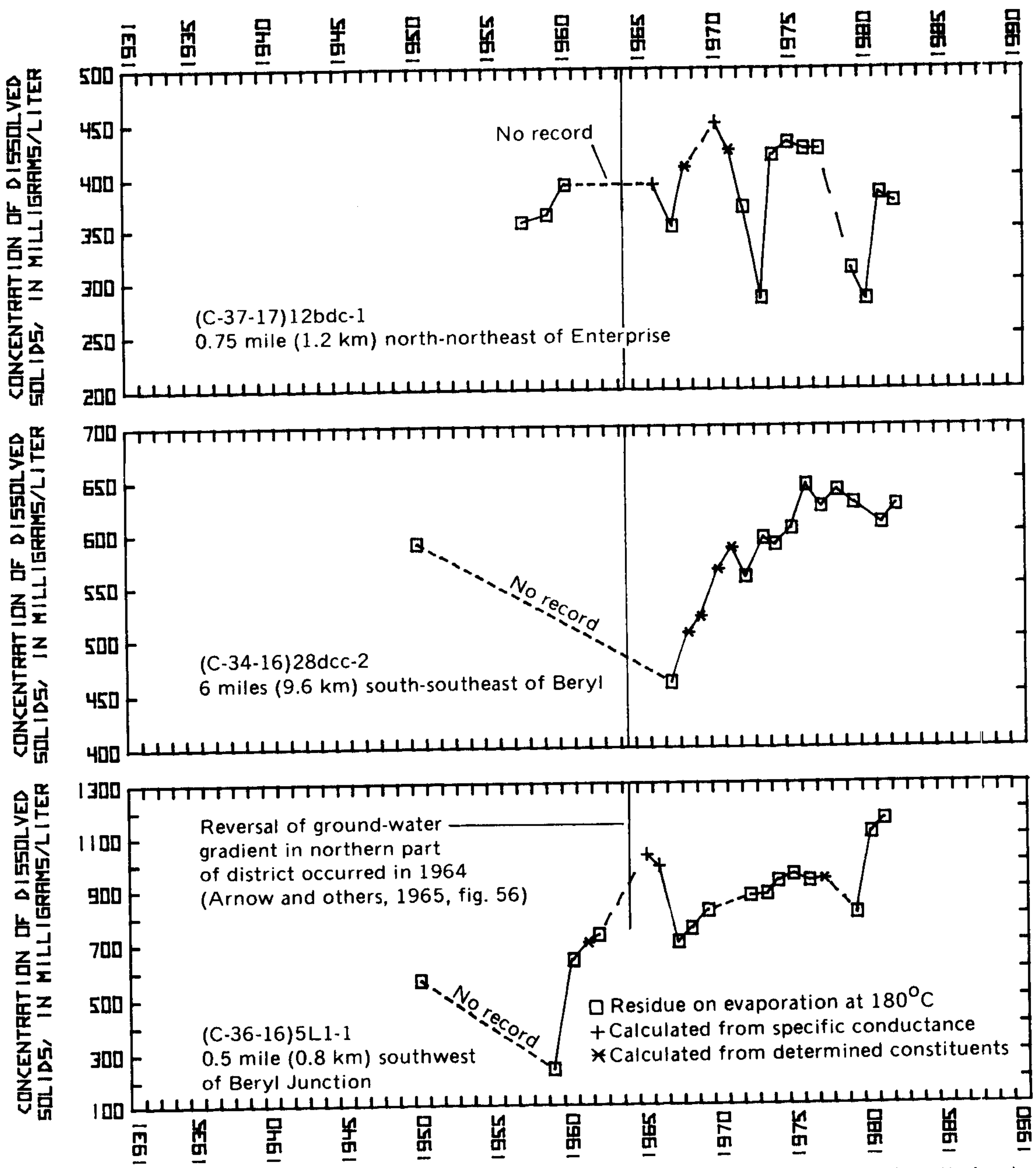


Figure 53.—Concentration of dissolved solids in water from selected wells in the Beryl-Enterprise area, Escalante Valley.

OTHER AREAS

by L. R. Herbert

Approximately 127,000 acre-feet (157 hm^3) of water was withdrawn from wells in 1982 in those areas of Utah listed below:

Number in figure 1	Area	Estimated withdrawal (acre-feet) 1982	1981
1	Grouse Creek valley	3,400	4,000
2	Park Valley	2,000	2,900
8	Ogden Valley	9,100	11,200
12	Dugway area Skull Valley Old River Bed	4,400	4,200
13	Cedar Valley	3,200	4,500
18	Sanpete Valley	11,400	14,200
23	Snake Valley	9,800	12,400
25	Beaver Valley	9,800	11,100
31	Central Virgin River area	26,700	22,000
	Remainder of State	47,200	18,500
	Total (rounded)	127,000	105,000

The total withdrawal was 22,000 acre-feet (27 hm^3) more than in 1981 and 28,000 acre-feet (34 hm^3) more than the 1972-81 average annual withdrawal (table 2). Of those areas listed, withdrawal in 1982 was greater than in 1981 in the Dugway area, Central Virgin River area, and the remainder of State. The increase in withdrawal mainly was due to continued large demands on the ground-water reservoirs for public supply and irrigation uses.

Figure 54 shows the relation between long-term hydrographs of 17 selected observation wells in areas and cumulative departure from average annual precipitation at sites in or near those areas. Water levels rose in 14 of the wells from March 1982 to March 1983. The rises were due to above average precipitation. Declines occurred locally due to increased withdrawals for public supply and irrigation.

Figures 55 and 56 show changes of water levels in Cedar and Sanpete Valleys from March 1982 to March 1983. Water levels in both valleys rose, due to above average precipitation and less ground-water withdrawal for irrigation. Water levels also generally rose from March or April 1963 to March 1983 in both valleys (figs. 57 and 58). Rises of almost 10 feet (3.0 m) were recorded in Sanpete Valley and of almost 32 feet (9.8 m) in Cedar Valley. Declines of less than 5 feet (1.5 m) occurred in the east side of Cedar Valley.

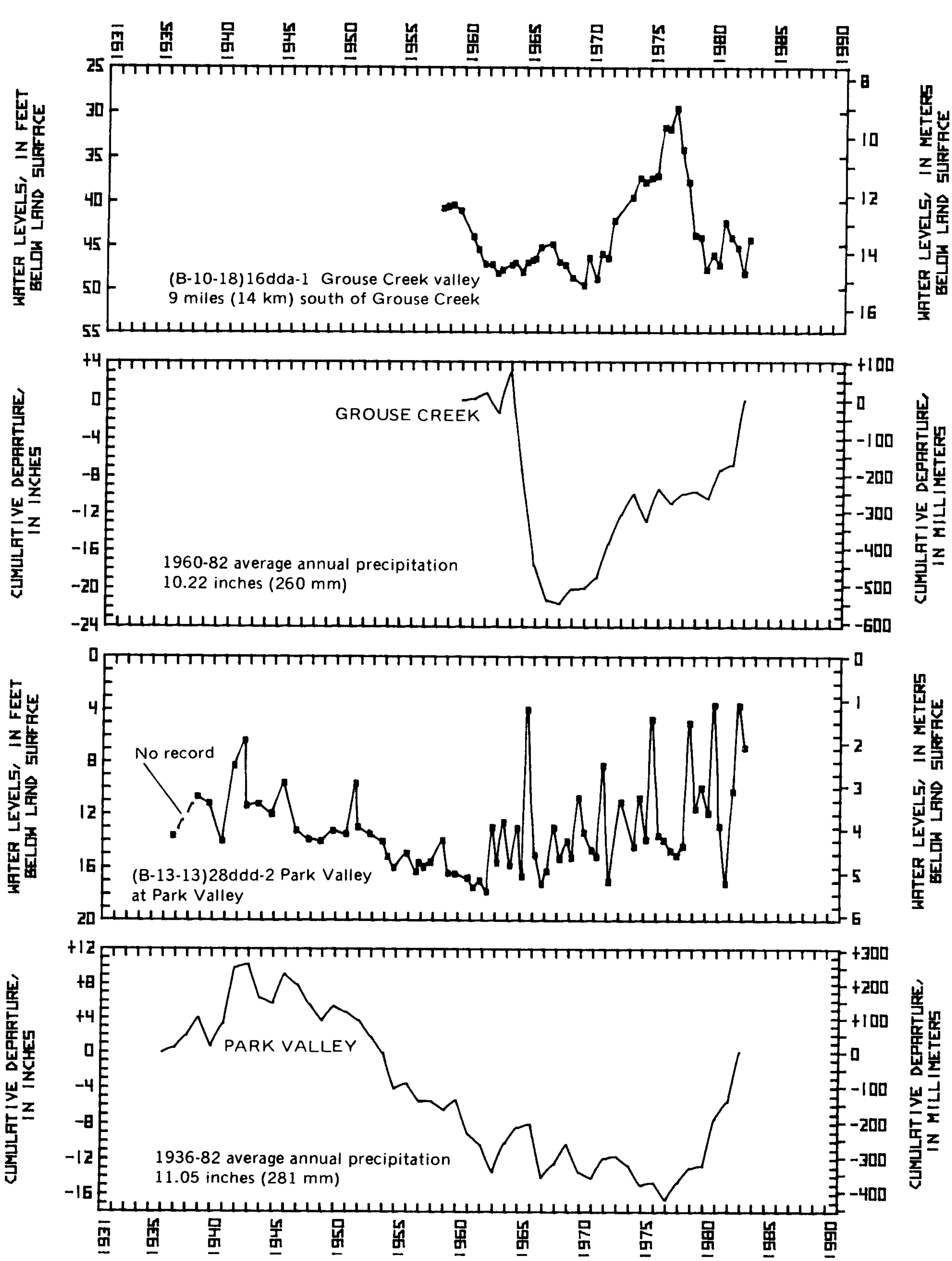
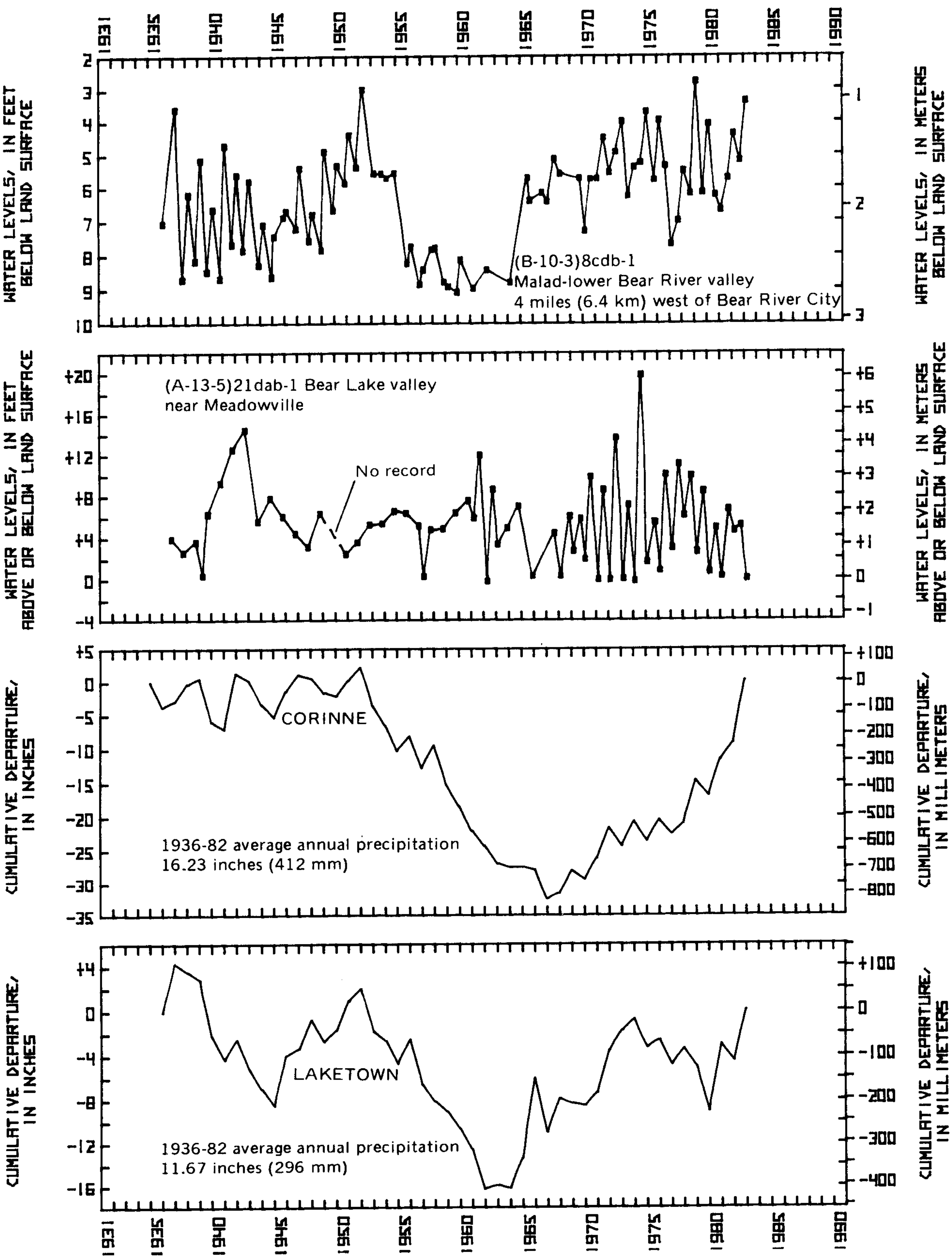


Figure 54.—Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas, and also total withdrawals from wells in "Other areas."



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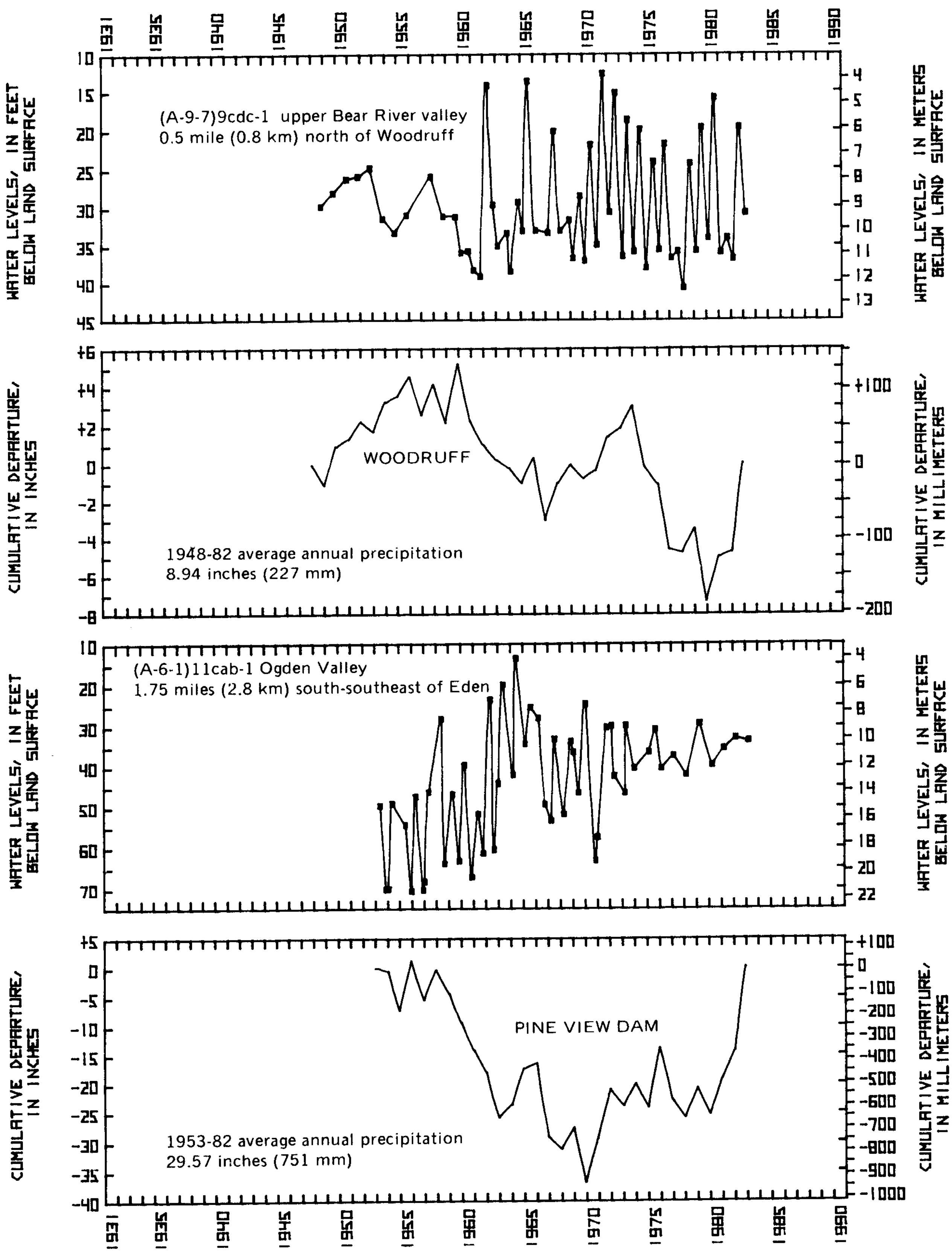

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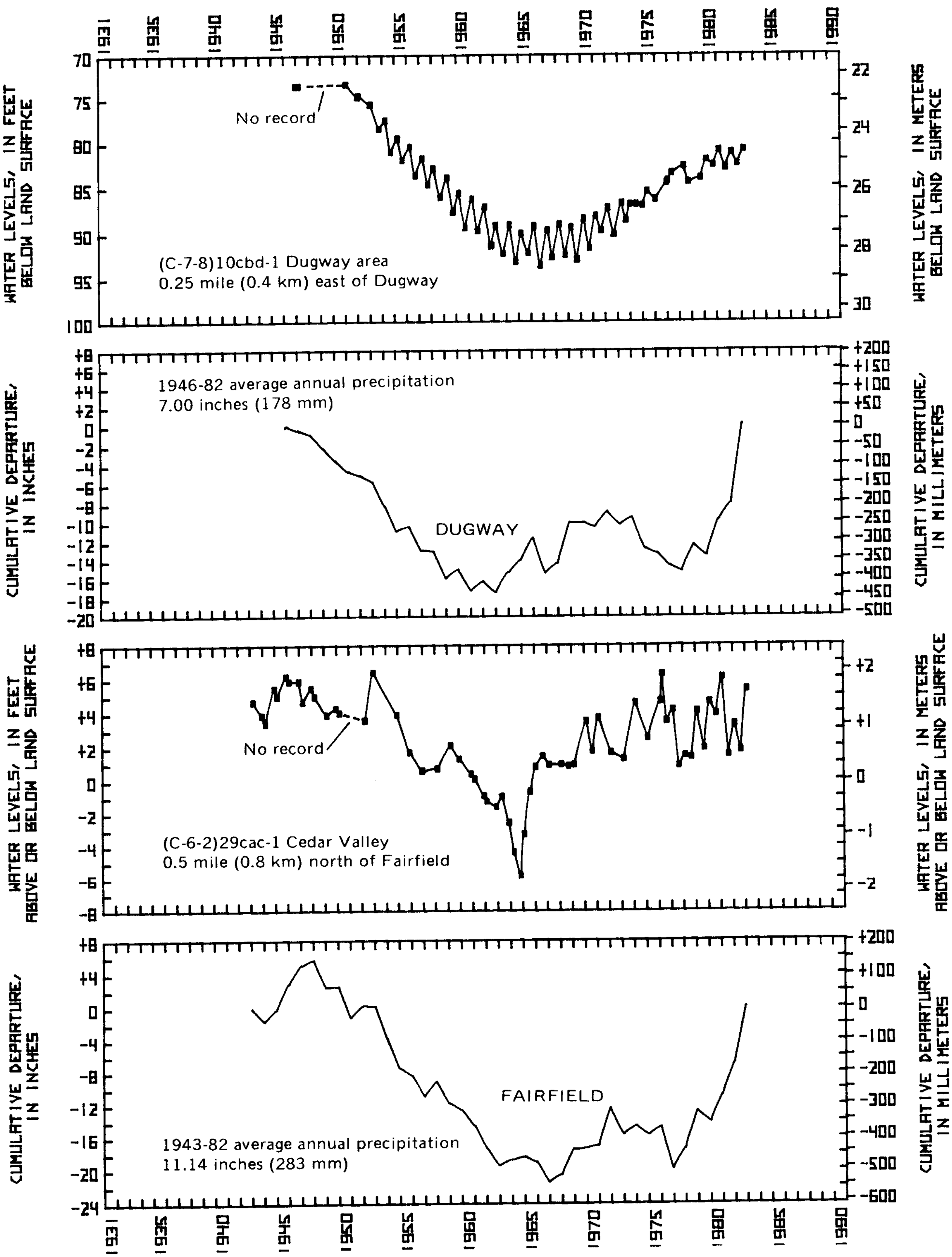

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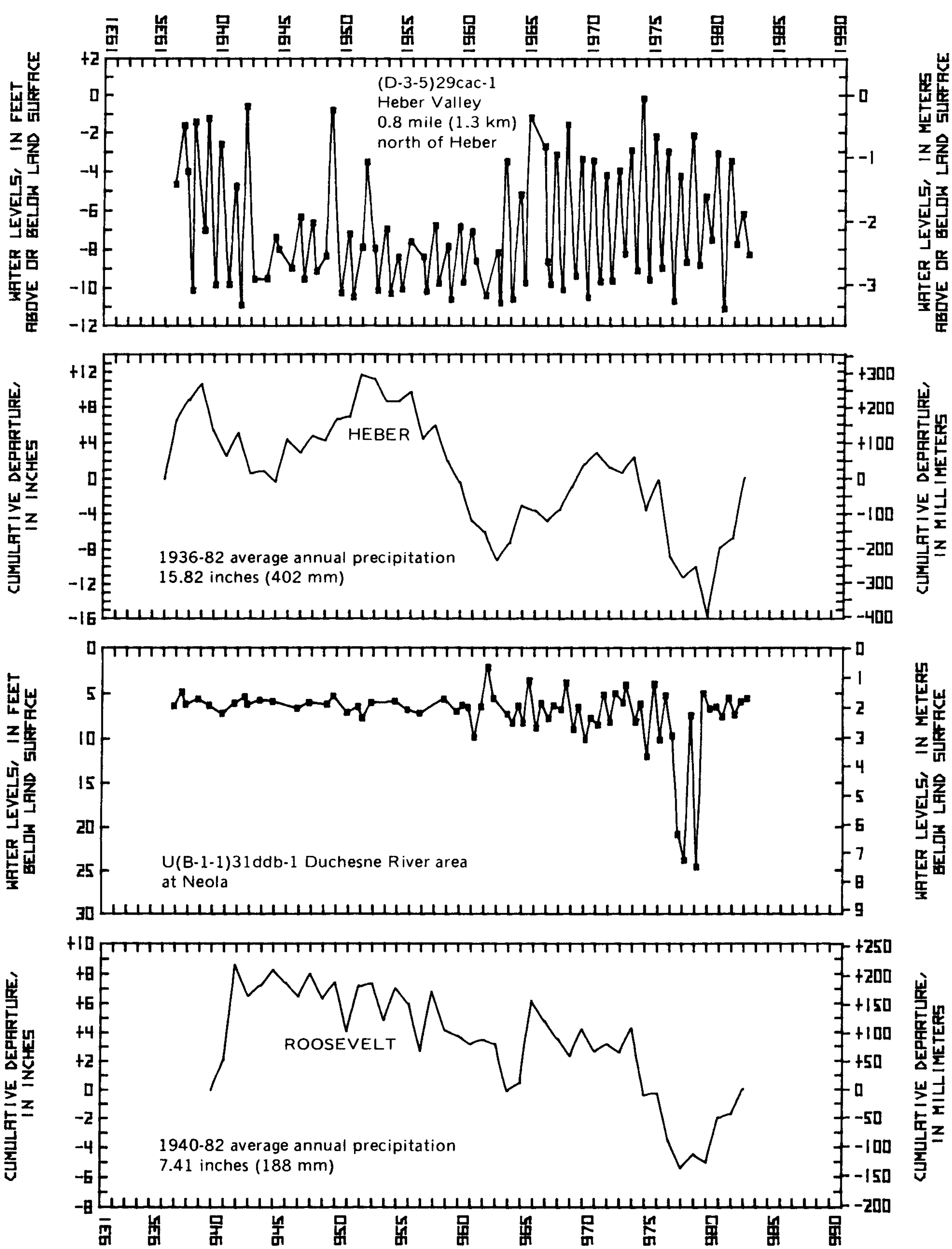

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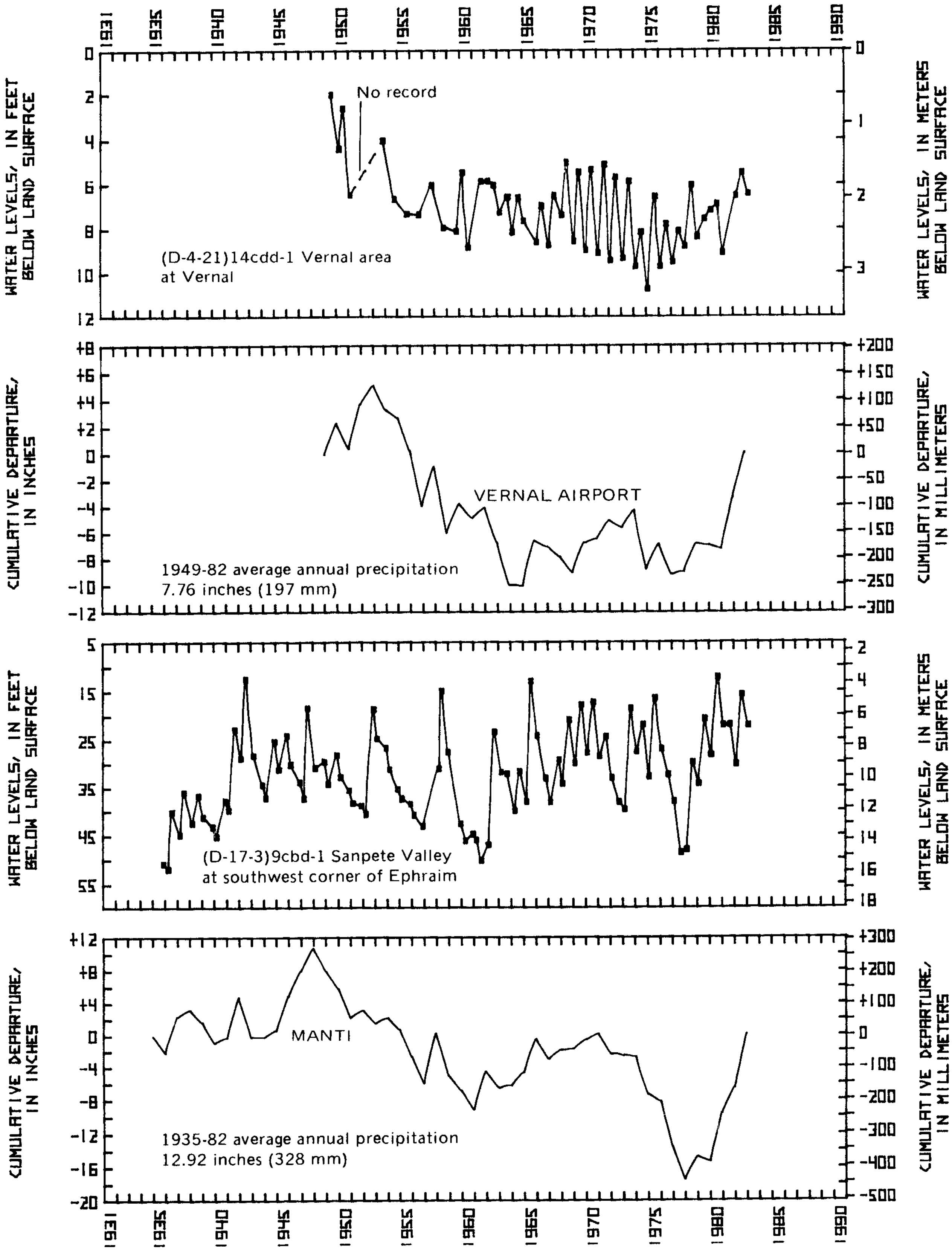

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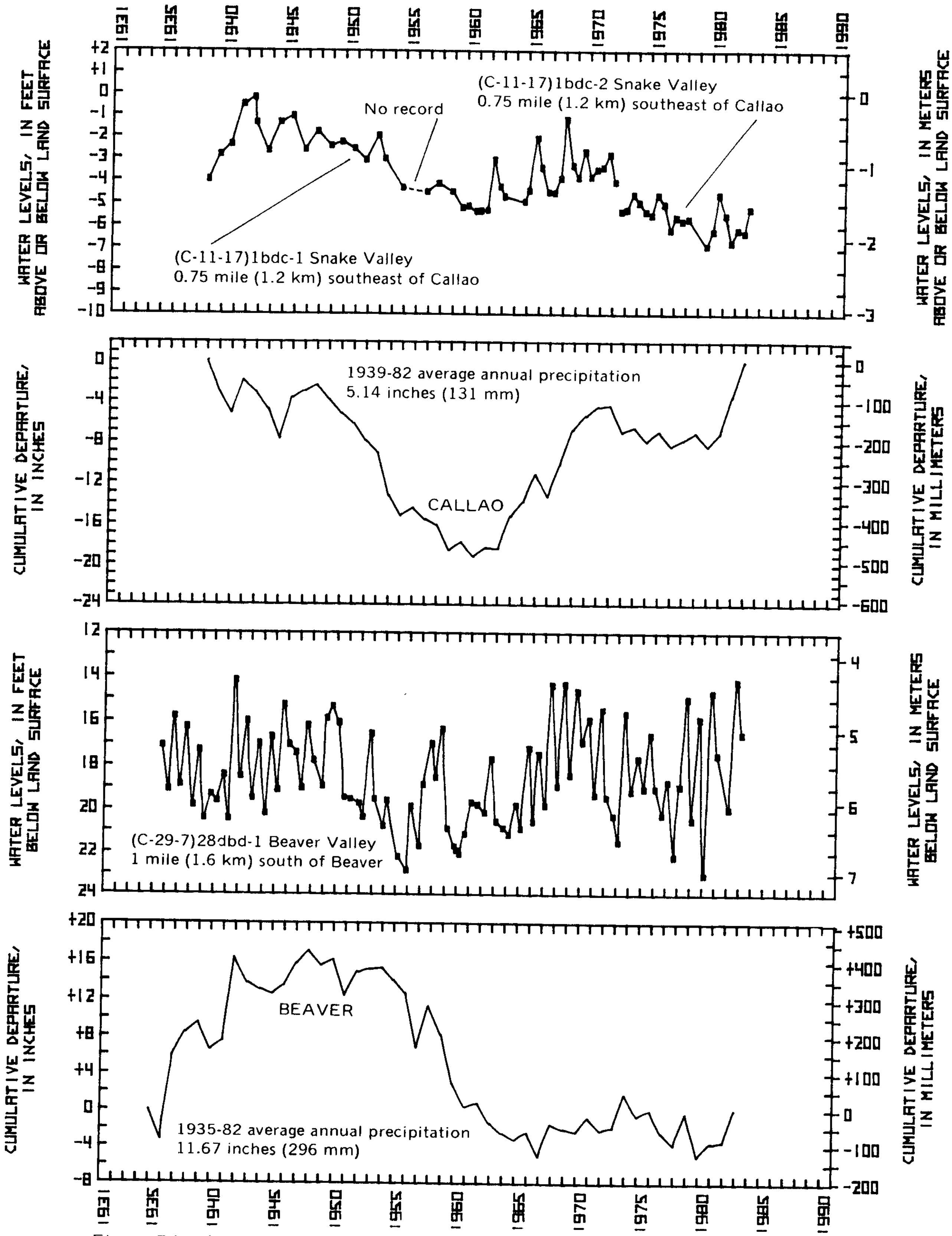

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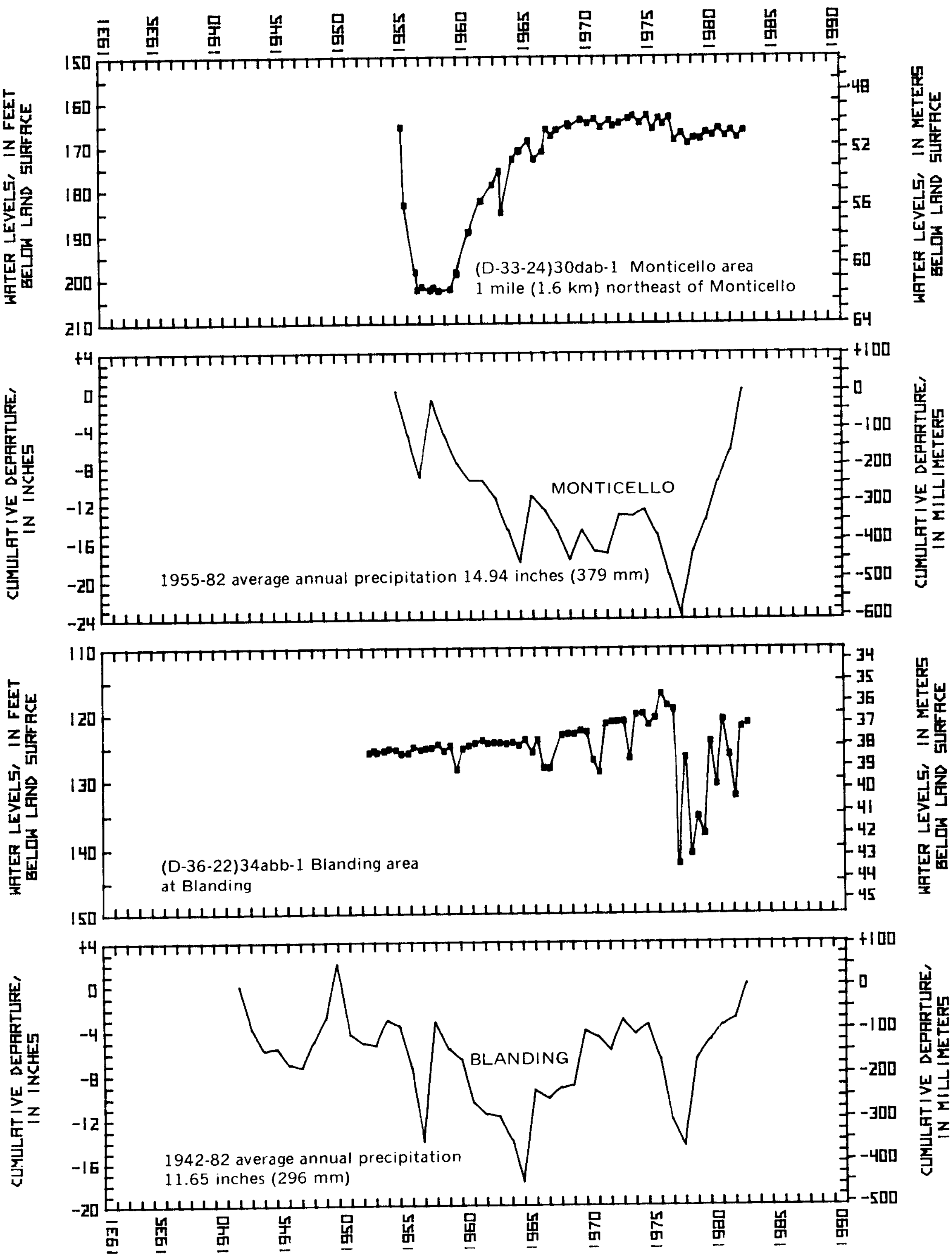

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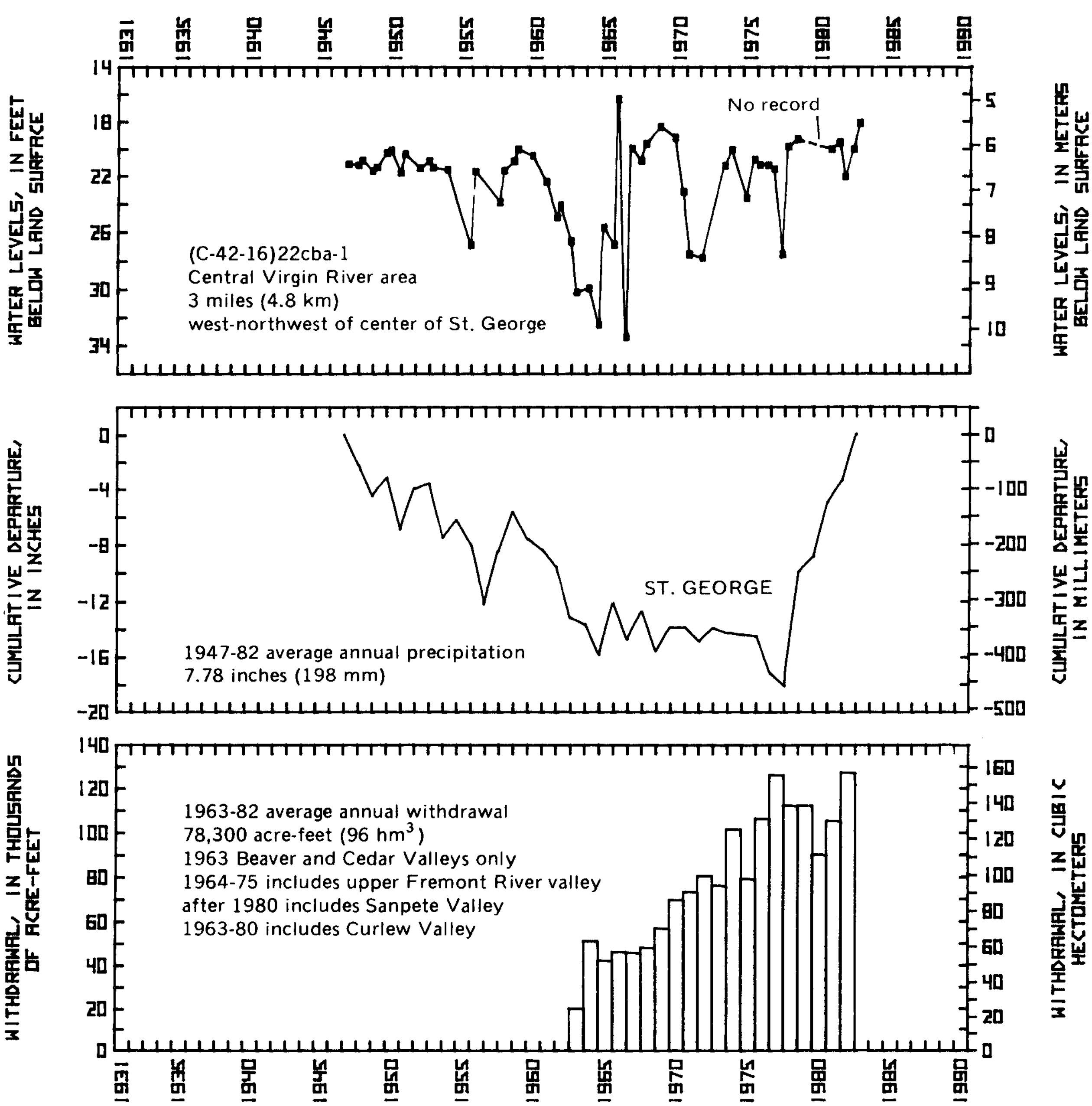

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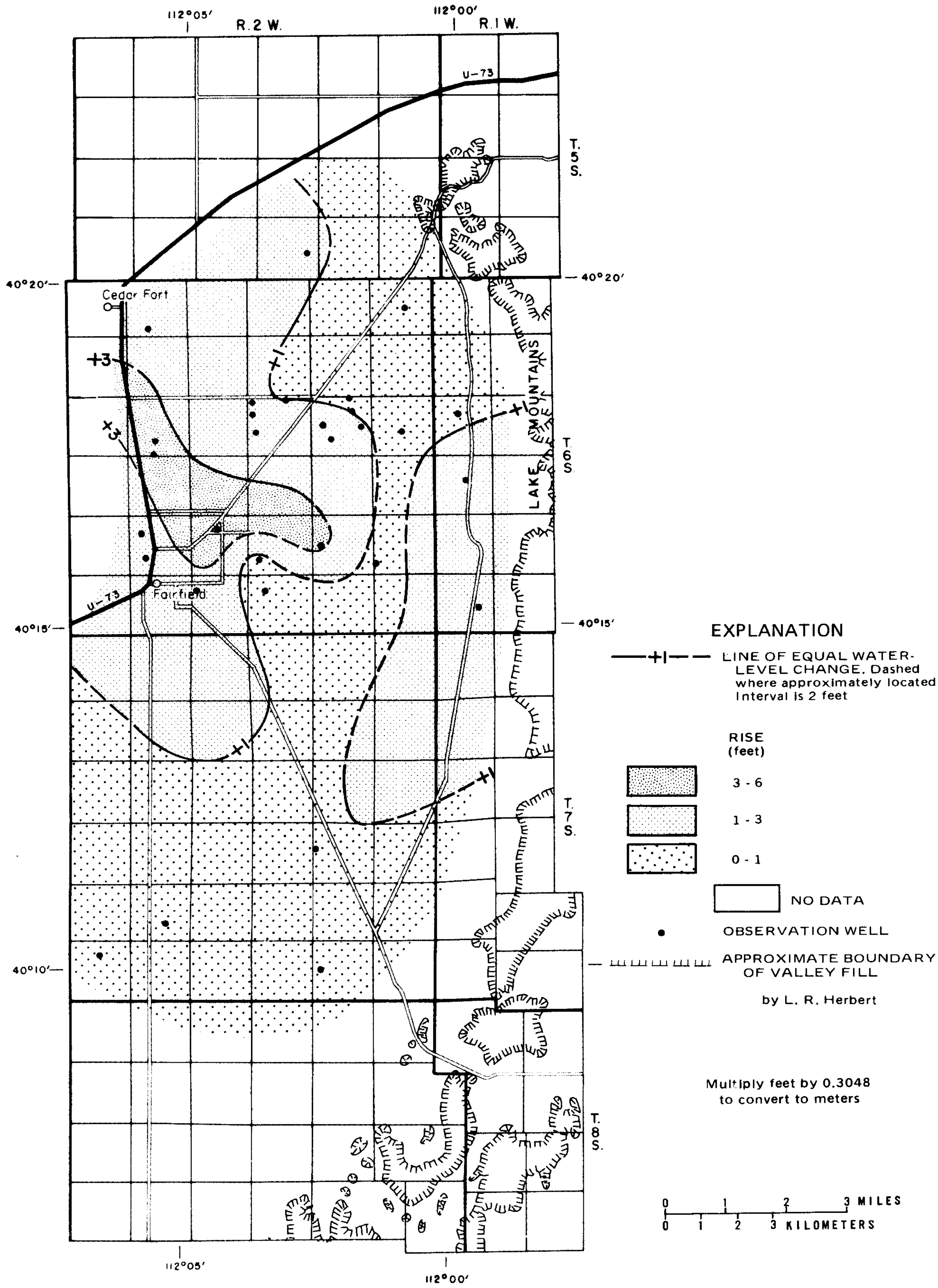

Figure 55.—Map of Cedar Valley showing change of water levels from March 1982 to March 1983.

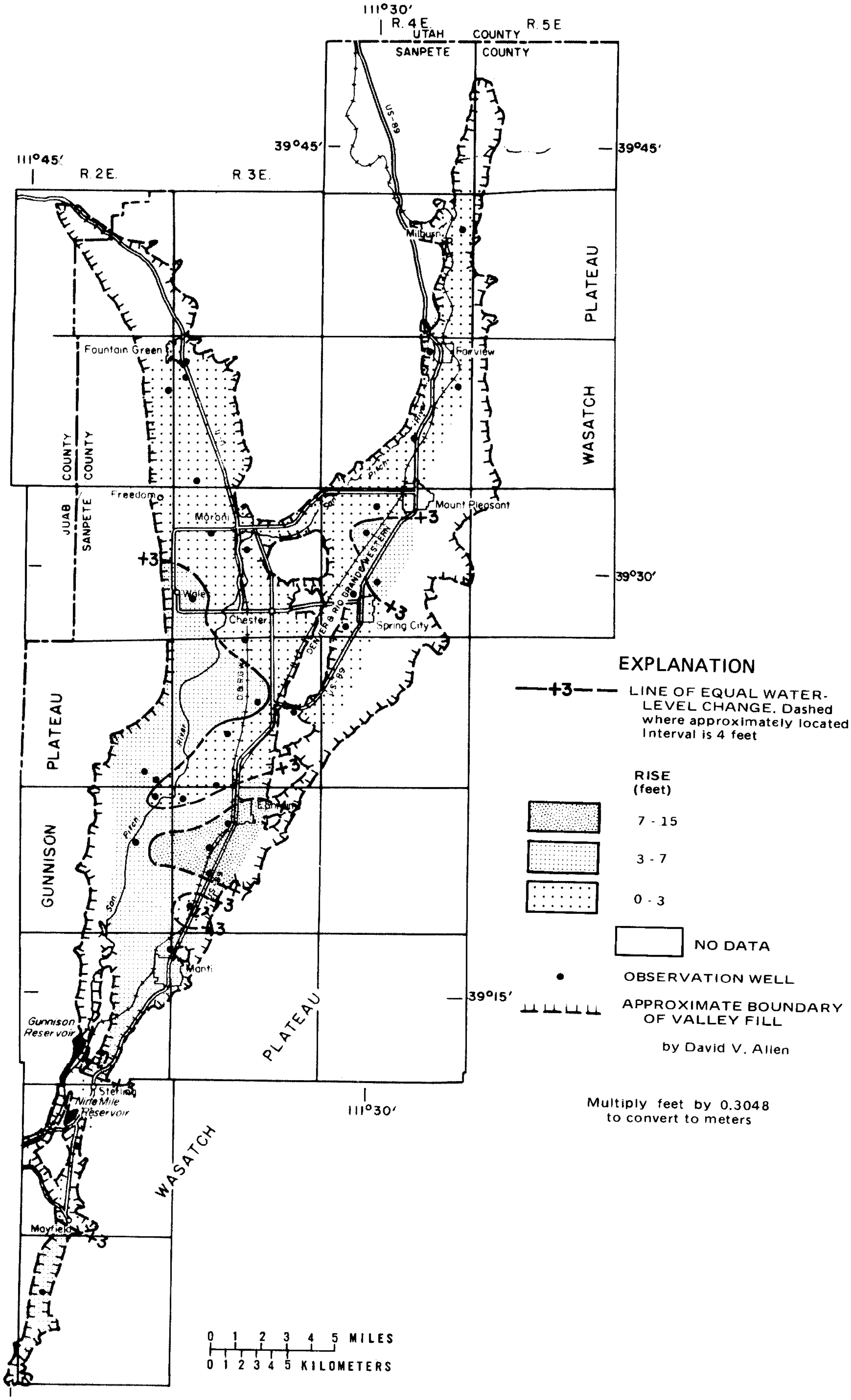

Figure 56.—Map of Sanpete Valley showing change of water levels from March 1982 to March 1983.

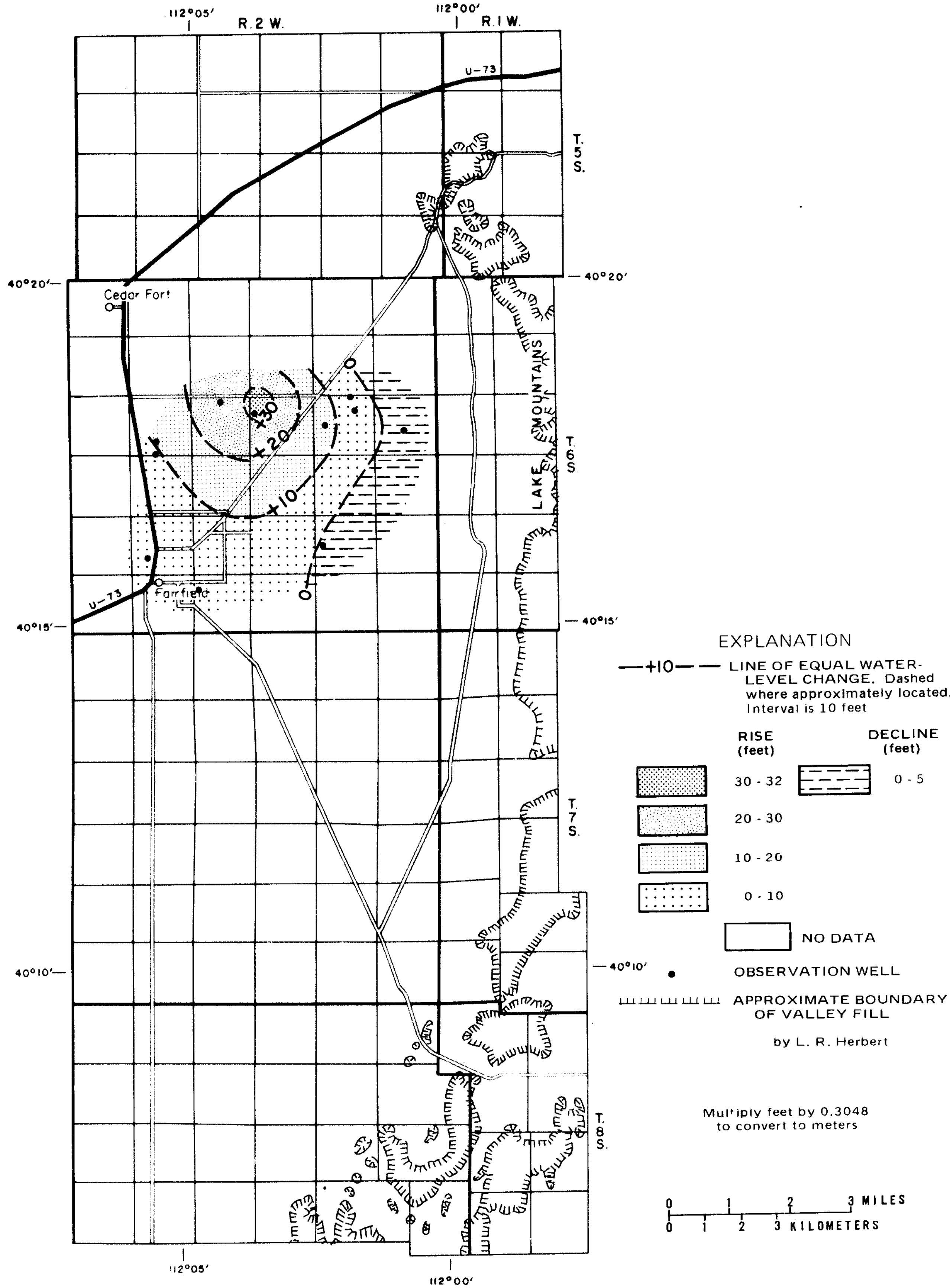

Figure 57.—Map of Cedar Valley showing change of water levels from March 1963 to March 1983.

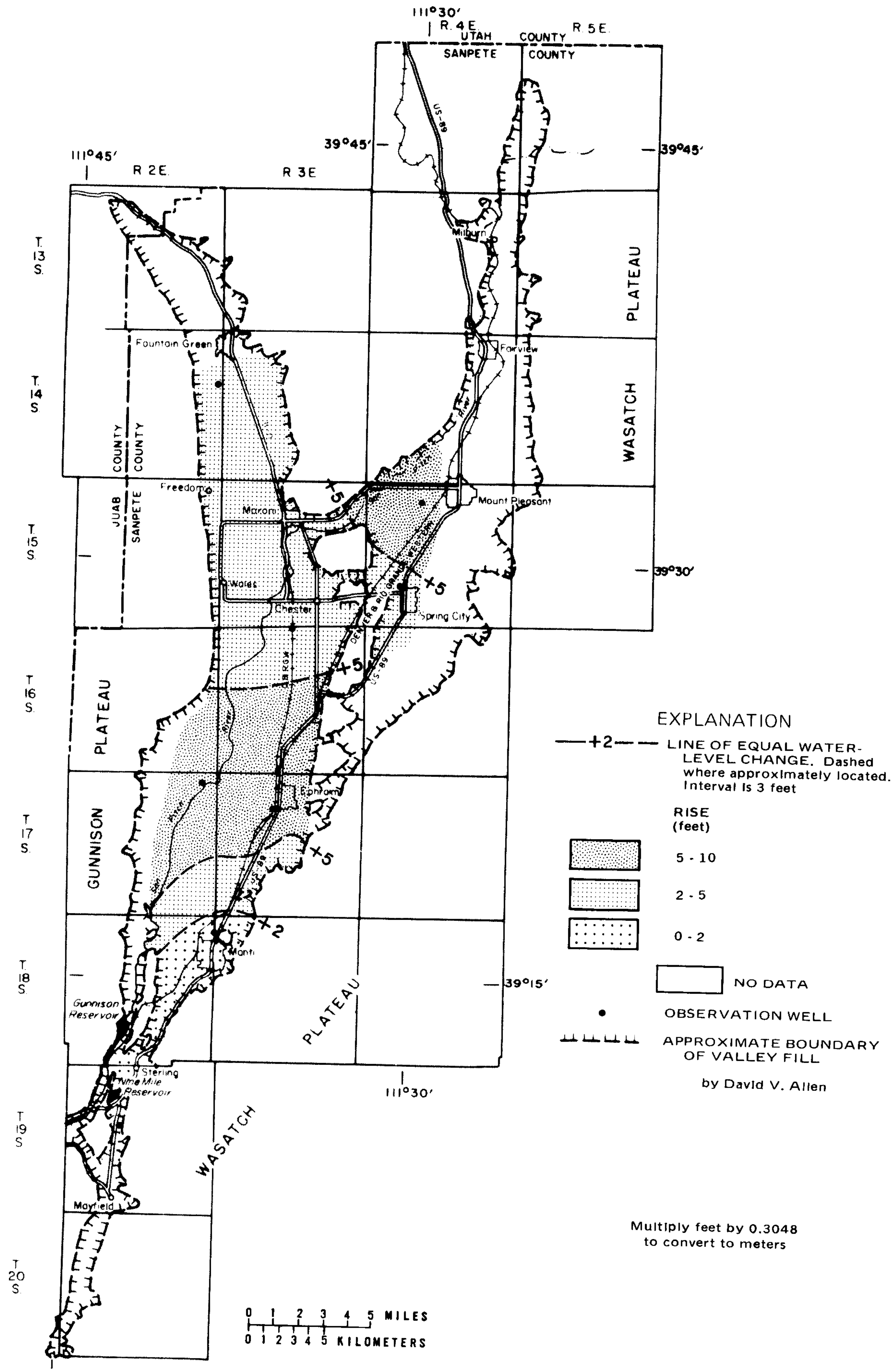

Figure 58.—Map of Sanpete Valley showing change of water levels from April 1963 to March 1983.

REFERENCES CITED

Arnow, Ted, and others, 1965, Ground-water conditions in Utah, spring of 1965: Utah Division of Water Resources Cooperative Investigations Report 3, 99 p.

Holmes, W. F., and others, 1982, Ground-water conditions in Utah, spring of 1982: Utah Division of Water Resources Cooperative Investigations Report 22, 85 p.

National Oceanic and Atmospheric Administration, Environmental Data and Information Service, 1983, Climatological data (annual summary, 1982): v. 84, no. 13.

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